HEATHKIT® MANUAL

for the

2-METER FM AMPLIFIER

Model HA-202

595-1503-02

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571
Technical Assistance:	
R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Strobe Lights, Calculators, Clocks, Weather Instruments	(616) 982-3315
Television	(616) 982-3307
Automotive, Marine, Appliances, Security, General Products	(616) 982-3496

YOUR HEATHKIT 90-DAY FULL WARRANTY

During your first ninety (90) days of ownership, Heath Company will replace or repair free of charge — as soon as practical — any parts which are defective, either in materials or workmanship. You can obtain parts directly from Heath Company by writing us or telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that, during the first ninety (90) days of ownership, our products, when correctly assembled, calibrated, adjusted, and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period, through no fault of yours, we will service it free upon delivery at your expense to the Heath factory, Benton Harbor, Michigan, or to any Heathkit Electronic Center (units of Schlumberger Products Corporation), or through any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty, both expressed and implied, does not cover damage caused by use of corrosive solder, defective tools, incorrect assembly, misuse, fire, customer-made modifications, flood or acts of God, nor does it include reimbursement for customer assembly or setup time. The warranty covers only Heath products and is not extended to non-Heath allied equipment or components used in conjunction with our products or uses of our products for purposes other than as advertised.

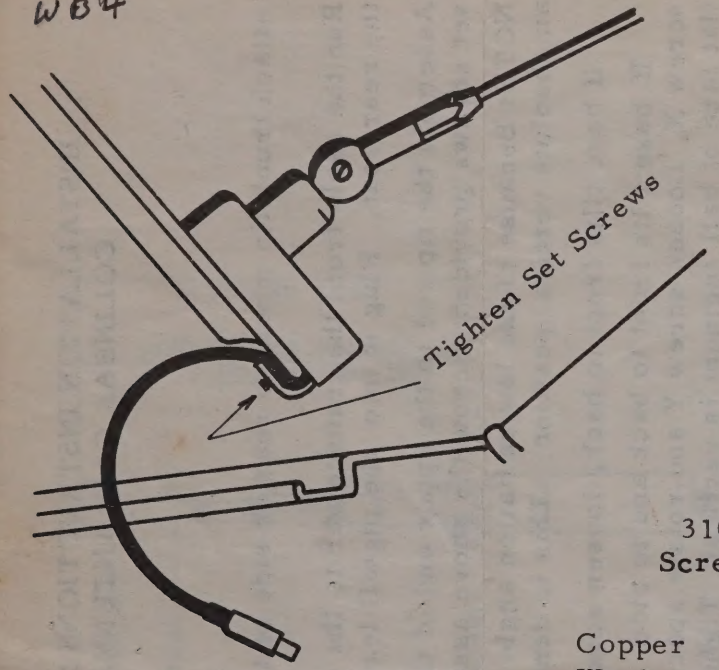
And if you are dissatisfied with our service — warranty or otherwise — or our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan, 49022. He'll make certain your problems receive immediate, personal attention.

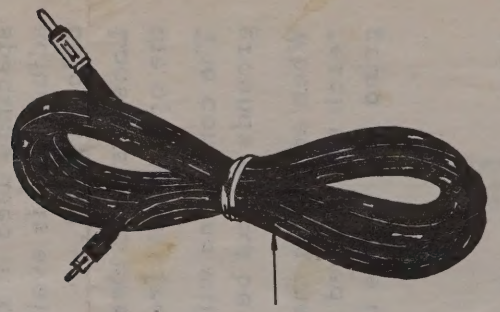
HEATH COMPANY
BENTON HARBOR, MI. 49022

Prices and specifications subject to change without notice.

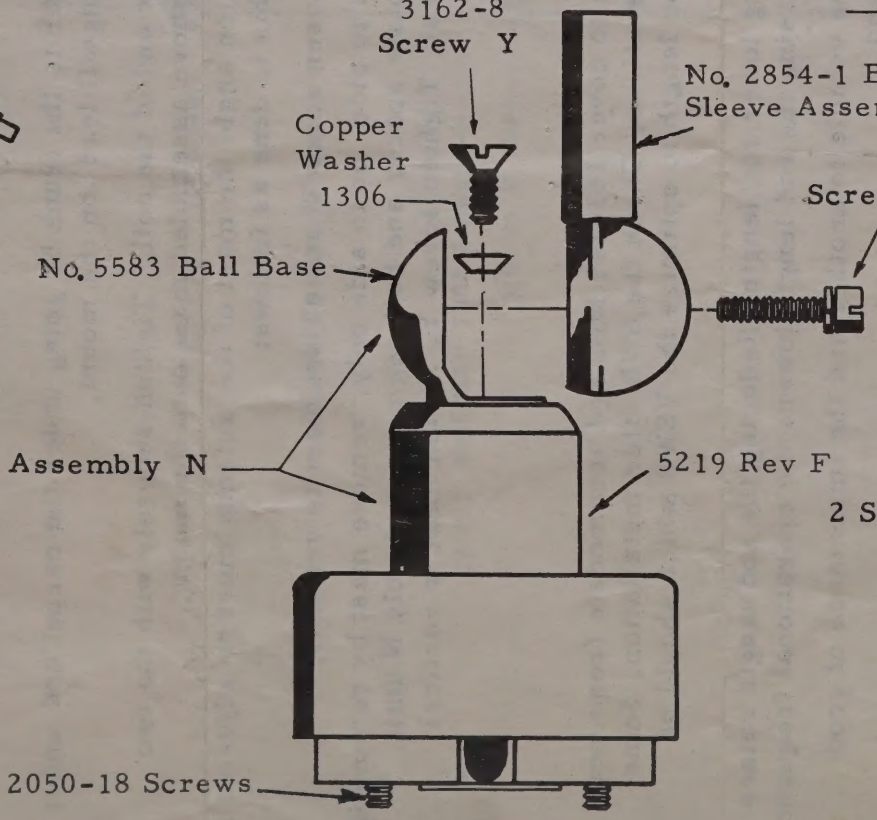
WA4ISDZ

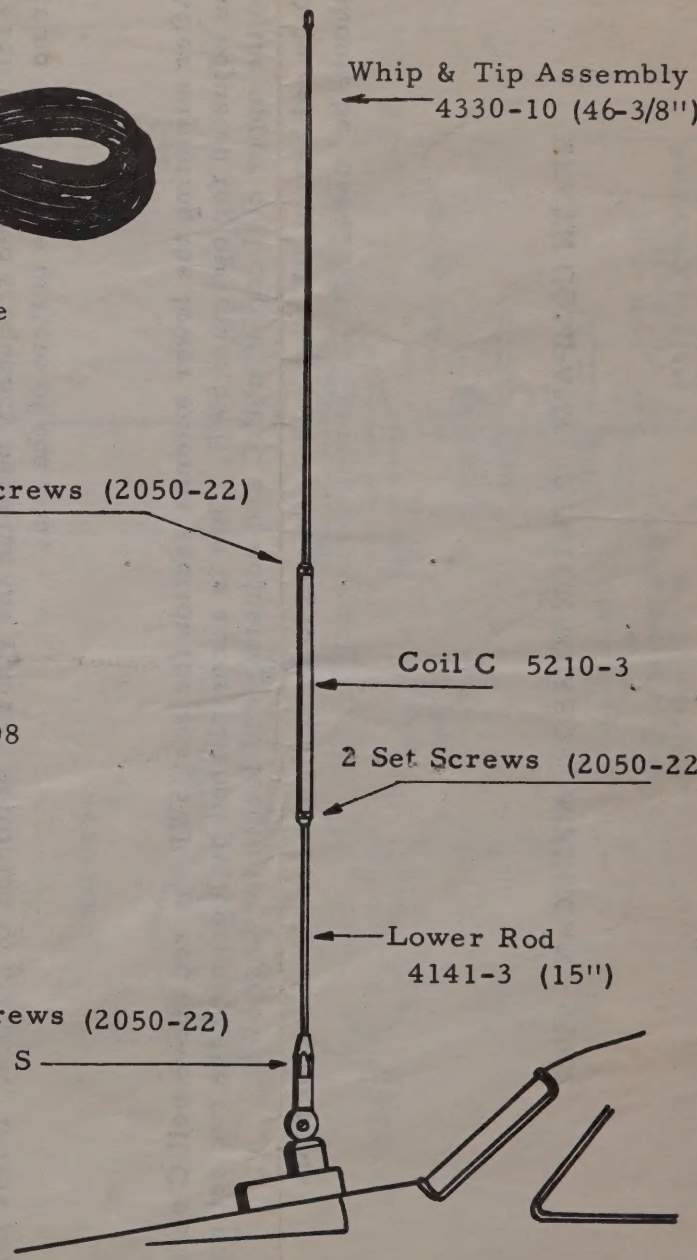
WB4





No. 194-SB Cable Assembly





Printed in U.S.A.

No. 5520 Mount Assembly (less 2050-18)

5572-1 R8/75

INSTALLATION INSTRUCTIONS FOR THE HEATH MOBILE COLINEAR GAIN ANTENNA, MODEL HWA-202-9

Attach trunk lip mount to rear or side of trunk lid as shown in the illustration.

Run the cable from the transceiver to the trunk by going under the carpet and under the rear seat. Plug it into the pigtail lead on the mount.

Assemble the tip rod to the upper end of the coil. Tighten securely with the two set screws provided. Screw the above assembled mast onto the mount.

NOTE: Because of the low radiation angle the mast of the antenna must be adjusted to an absolute vertical position. This is done as follows:

If base tilts front to back, loosen screw X and adjust mast to vertical.

If base tilts front to back and to side, or to side only, remove mast by removing screw X. Loosen screw Y and rotate spacer and ball segment assembly N until flat face of ball segment is vertical. Tighten screw Y. Attach mast in vertical position and tighten screw X.

TUNING INSTRUCTION

The antenna is sufficiently broad to cover 143-149 MHz and accomodate frequency spacings used in all repeater operations. Check the SWR after installation. Some adjustment is available on the rod length to optimize the VSWR which should be below 1.5 : 1.

Loosen set screws S for adjusting lower rod length. Reducing the rod length raises the operational frequency. Increasing the rod length lowers the operational frequency.

The conditions will vary from one vehicle to another and the importance of good grounds cannot be over emphasized.

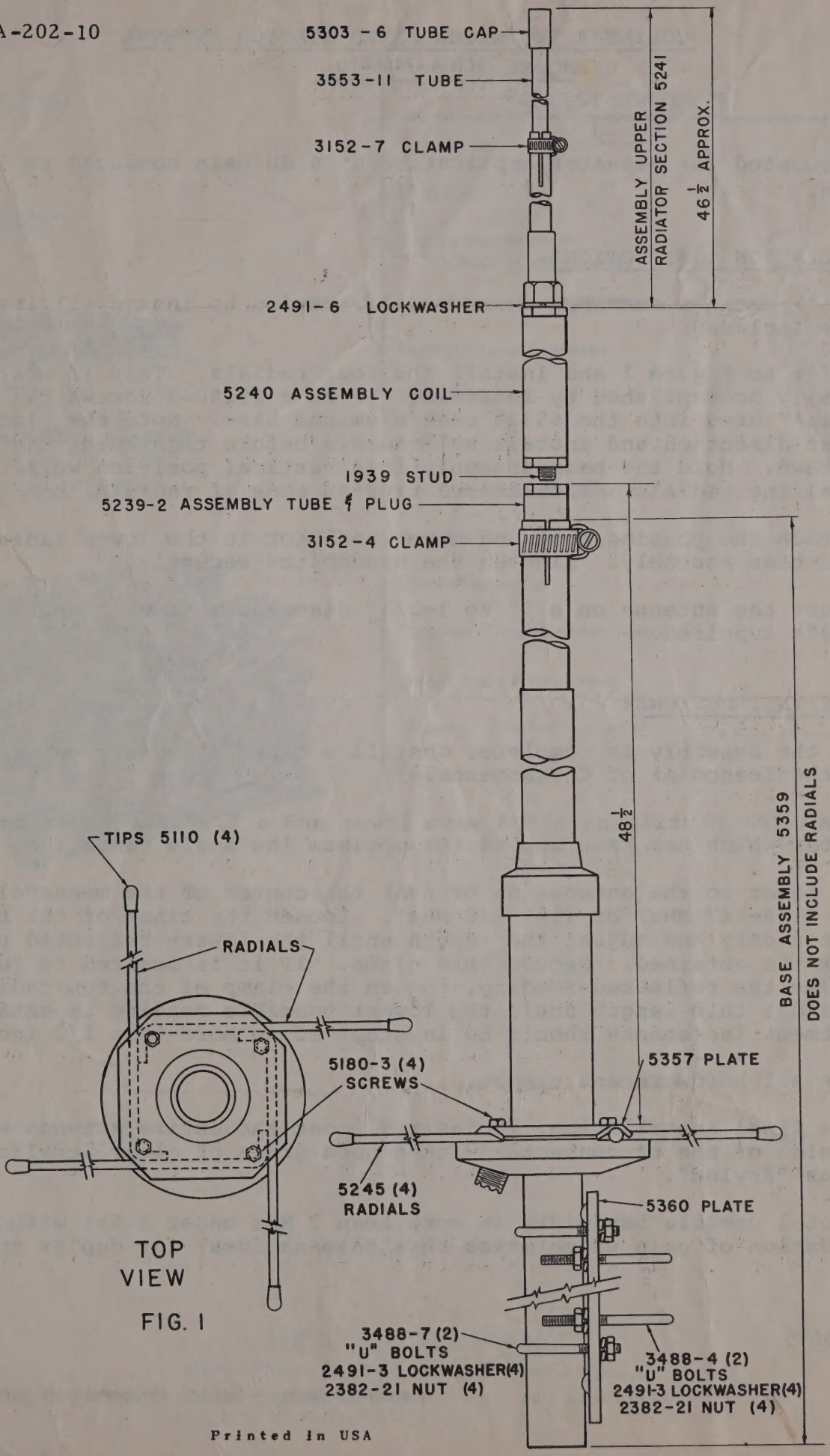
When adjusting the rod for the higher end of the range you might find you cannot reach the desired frequency because the rod has bottomed in the post. If this happens grind 1/4" off the bottom of the rod.

After adjusting the lower antenna section for best SWR the rod above coil C should be adjusted for optimum SWR. This is accomplished by loosening the two set screws in the upper coil cap of coil C and adjusting rod length for best SWR.

Only calibrated RF watt meters known to be designed for these frequencies should be used.

HEATH COMPANY BENTON HARBOR, MICHIGAN 49022

5572 Kit No. 5566 Printed in U.S.A.



TOP VIEW

FIG. 1

Printed in USA

COLINEAR TWO METER FIXED STATION ANTENNA
MODEL HWA-202-10

FCC accepted for Repeater application at 6 db gain compared to 1/2 wave dipole.

INSTALLATION INSTRUCTIONS:

1. Check package contents against illustration to insure all items are included.

2. Refer to Figure 1 and install the four radials. This is most easily accomplished by inserting the four #5180-3 screws two to three turns into the #5328 cast aluminum base. Note the clockwise direction and install all radials before tightening the four screws. Hold the base assembly in a vertical position while installing radials. Install red tips on ends of radials.

3. Attach the phasing coil and upper radiator to the lower radiator and base assembly. Tighten the assemblies securely.

4. Mount the antenna on a 1" to 1-3/4" diameter mast with the "U" bolts supplied.

TUNING INSTRUCTIONS:

After the assembly is complete, install a dependable watt meter at or near the feedpoint of the antenna.

The HWA-202-10 utilizes a 5/8 wave lower and a 5/8 wave upper colinear radiator which has been spaced for optimum low angle radiation.

Apply power to the antenna on or near the center of the megacycle to be used, (146-147 MHz) or (147-148 MHz). Loosen the clamp of the bottom radiator only and adjust the length until the lowest reflected power or VSWR is obtained. Secure this clamp. If it is desired to further minimize the reflected reading, loosen the clamp of the top radiator and adjust this length until the lowest possible reading is obtained. Adjustment increments should be in steps of no more than 1/2 inch.

Secure all hardware and clamps.

Before final installation, if desired, coat the entire antenna with the exclusion of the rf connector with a good grade of clear acrylic lacquer such as "Krylon".

The total useable bandwidth is more than 2 MHz under 1.5:1 without degradation of gain which makes this antenna ideal for duplex operation.

Kit No. 5575

5571 Printed in USA Heath Company - Benton Harbor Michigan 49022

Price $2.00

Assembly and Operation of the

HEATHKIT®

2-METER FM AMPLIFIER

MODEL HA-202

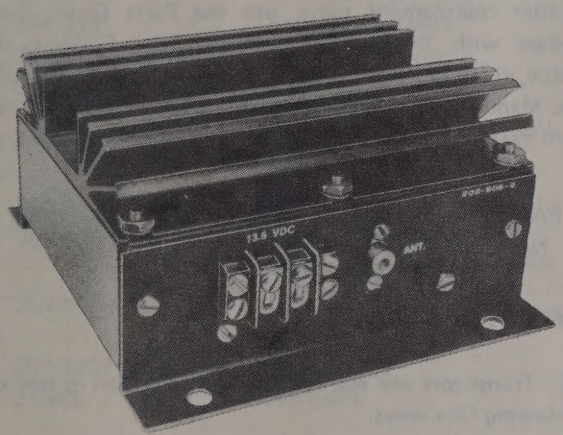


TABLE OF CONTENTS

Introduction	2
Parts List	2
Step-by-Step Assembly	4
Circuit Board Assembly	4
Chassis Assembly and Wiring	12
Installation and Alignment	14
Operation	21
In Case of Difficulty	21
Troubleshooting Chart	22
Specifications	23
Circuit Description	24
Diode and Transistor Identification	25
Circuit Board X-Ray Views	26
Schematic (fold-out from page)	27
Chassis Photographs	28

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

Copyright © 1972
Heath Company
All rights reserved

INTRODUCTION

The Heathkit Model HA-202 Amplifier is a compact 2-meter amplifier designed for mobile FM operation in conjunction with a transmitter or transceiver capable of supplying 5 to 15 watts of FM driving power. The output power of the Amplifier will be between 20 and 50 watts, depending upon the driving power.

For alignment, a wattmeter (or SWR bridge) is preferred, but you may use a voltmeter. A 50 Ω noninductive load should be available for the output.

This Amplifier features automatic antenna switching and all-solid-state design, assuring you of stable, trouble-free operation. Rugged, emitter-ballasted transistors, combined with an efficient heat sink, provide adequate VSWR protection without the use of complex sensing circuits. Cable, hardware, and connectors are supplied for installation.

The Amplifier is designed for operation from a 12 volt DC, negative ground system. Additional power supplies are not required.

Read the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedure.

PARTS LIST

This list contains all of the parts used in the assembly of this kit. Some parts may be packaged in envelopes with the part number of the contents printed on the outside. Except for the initial parts check, retain these parts in their envelopes until they are called for in the assembly steps. When more than one number is on a package, disregard all but the part number listed in the "Parts List."

Check each part against the following list. The key numbers correspond to the numbers on the Parts Pictorial (fold-out from Page 5).

To order replacement parts, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual. For pricing information, refer to the separate "Heath Parts Price List."

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
RESISTORS (1/2-Watt, 10%)			
A1	1-41	2	10 Ω (brown-black-black)
A1	1-9	1	1000 Ω (brown-black-red)
A1	1-16	1	4700 Ω (yellow-violet-red)
CAPACITORS			
Mica			
A2	20-99	3	22 pF
A2	20-101	6	47 pF
A2	20-76	1	68 pF
A2	20-102	1	100 pF
Other			
A3	21-149	1	2.7 pF disc
A3	21-140	1	1000 pF disc (.001 μF)
A4	25-834	1	22 μF tantalum
A5	31-52	4	Trimmer (8-60 pF)

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
TRANSISTORS-DIODES			
NOTE: Transistors are marked for identification in one of the following four ways. 1. Part number. 2. Transistor type number. 3. Part number and transistor type number. 4. Part number with a transistor type other than the one listed.			
B1	417-155	1	2N3641 transistor
B2	417-299	2	2N5591 or CTC B25-12 transistors
B3	56-56	2	1N4149 diode (may be marked yellow-brown-yellow-white)
CONNECTORS-TERMINALS-CLAMPS			
B4	207-5	1	3/16" cable clamp
B4	207-4	1	1/4" cable clamp
B5	431-70	1	Terminal strip
B6	432-72	2	Male pin
B7	432-73	2	Female pin

KEY No.	PART No.	PARTS Per Kit	DESCRIPTION
Connectors-Terminals-Clamps (cont'd.)			
B8	432-121	6	Connector pin (2 extra)
B9	432-137	1	1/4" push-on connector
B10	432-720	1	Female connector housing
B11	432-723	1	Male connector housing
B12	434-42	2	Phono socket
B13	438-4	2	Phono plug
WIRE-CABLE-SLEEVING			
	343-2	1	RG-58A/U coaxial cable
	343-12	1	RG-174 coaxial cable
	340-1	1	#14 bare wire
	344-7	1	Stranded black wire
	344-118	1	Stranded red wire
	348-1	1	#24 magnet wire
	346-1	1	Sleeving
METAL PARTS			
C1	200-649-2	1	Cover
C2	202-605-3	1	Right side chassis (INPUT)
C3	202-605-4	1	Left side chassis (ANT)
C4	205-1407	2	Spacer strip
C5	215-66	1	Heat sink
HARDWARE			
#4 Hardware			
D1	250-273	6	4-40 x 3/8" screw
D2	252-99	4	4-40 nut
D3	254-34	6	#4 lockwasher
#6 Hardware			
D4	250-237	9	#6 x 3/8" sheet metal screw
D5	250-234	4	6-32 x 1/2" screw
D6	252-77	4	6-32 nut
D7	254-25	3	#6 lockwasher
D8	259-1	1	#6 solder lug
#8 Hardware			
E1	252-78	4	8-32 nut
#10 Hardware			
E2	250-239	4	10-32 x 3/8" sheet metal screw
E3	250-443	6	10-32 x 1/2" screw
E4	252-63	6	10-32 nut
E5	254-36	6	#10 lockwasher
Other			
E6	253-89	2	D washer
E7	259-22	2	Spade solder lug
MISCELLANEOUS			
F1	45-74	1	RF choke
F2	69-70	1	Relay
	85-1246-1	1	Circuit board
F3	205-778	1	1" steel blade
F4	253-28	2	White "O" ring
F5	352-13	1	Silicone grease
	421-4	2	Fuse, 8A, 3AG (1 spare)
F6	422-1	1	Fuse block
F7	475-12	3	Ferrite bead
	391-34	1	Blue and white label
F8	490-5	1	Nut starter
F9	490-112	1	Extractor tool
	490-168	1	5/16" x 11/32" wrench
		1	Manual (See front cover for part number.)
	597-260	1	Parts Order Form
	597-308	1	Kit Builders Guide
			Solder

STEP-BY-STEP ASSEMBLY

Before starting to assemble this kit, read the "Kit Builders Guide" for complete information on wiring, soldering, and step-by-step assembly procedures.

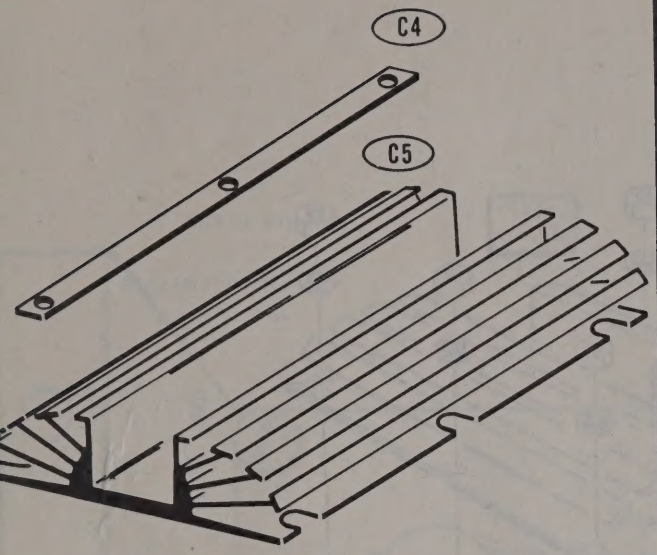
CIRCUIT BOARD ASSEMBLY

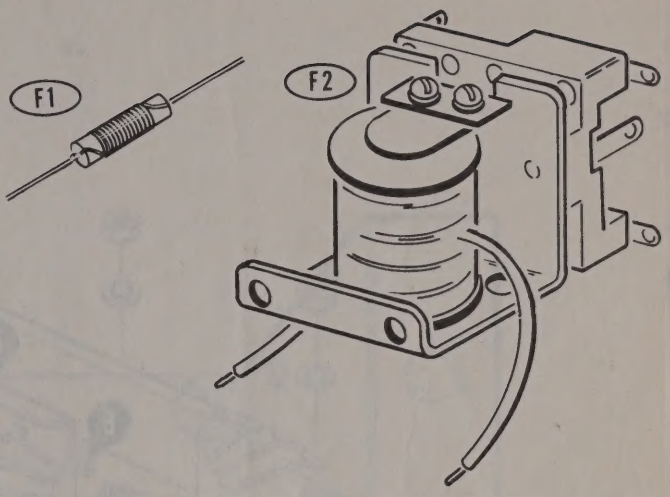
Resistors are designated by the color code (see the "Kit Builders Guide") and the resistance value. Capacitors are designated by their value and type.

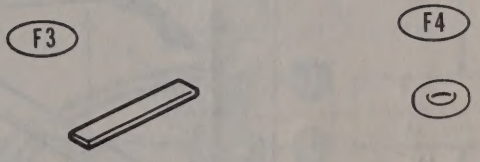
Use a minimum amount of solder and do not heat components excessively. Diodes and transistors can be damaged if subjected to excessive amounts of heat. Solder a part, or a group of parts, only when instructed to do so.

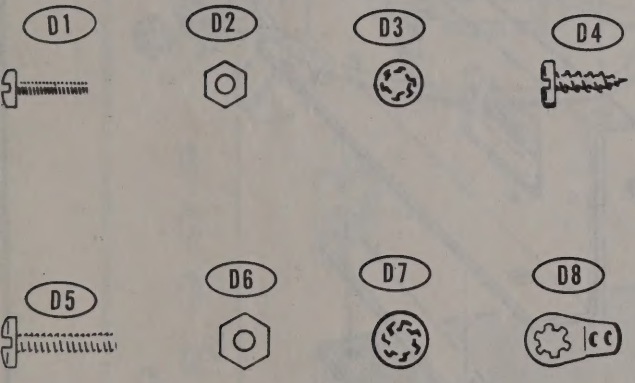
When you assemble the circuit board, the parts will usually be installed on the top of the board (the side with the component outlines), and the leads will be soldered to the foil (other) side. Solder the leads only to the foil side of the board.

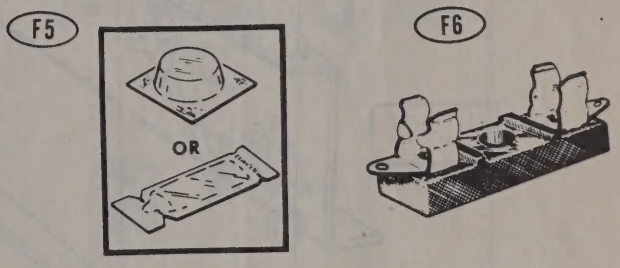
ORIAL


C4
C5

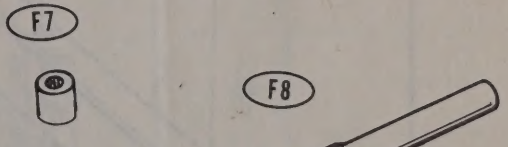

F1
F2

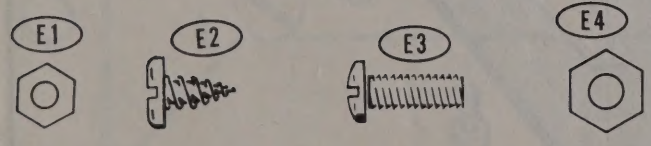

F3
F4

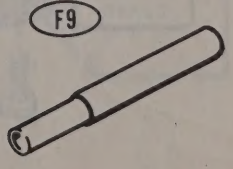

D1
D2
D3
D4

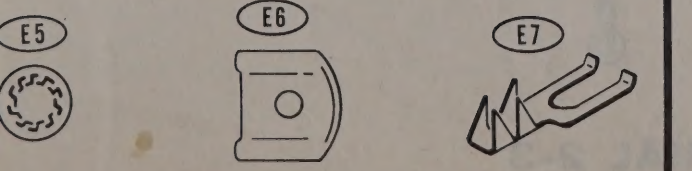

F5
OR
F6

D5
D6
D7
D8


F7
F8


E1
E2
E3
E4


F9


E5
E6
E7

STEP-BY-STEP ASSEMBLY

Before starting to assemble this kit, read the "Kit Builders Guide" for complete information on wiring, soldering, and step-by-step assembly procedures.

CIRCUIT BOARD ASSEMBLY

Resistors are designated by the color code (see the "Kit Builders Guide") and the resistance value. Capacitors are designated by their value and type.

Use a minimum amount of solder and do not heat components excessively. Diodes and transistors can be damaged if subjected to excessive amounts of heat. Solder a part, or a group of parts, only when instructed to do so.

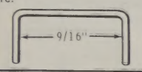
When you assemble the circuit board, the parts will usually be installed on the top of the board (the side with the component outlines), and the leads will be soldered to the foil (other) side. Solder the leads only to the foil side of the board.

START

NOTE: Only part of the circuit board is shown in each of the following Pictorials. An identification drawing at the top of each Pictorial shows the area of the circuit board to be assembled.

Position the circuit board as shown in the identification drawing. Then complete each step on Pictorials 1-1 through 1-7.

( ) Form two 1" lengths of #14 bare wire:

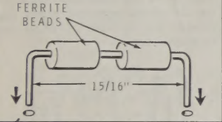


FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN... WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.

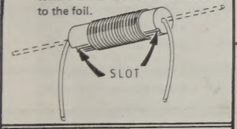
(✓) One formed bare wire at L6. Push the wire down flat against the board. Solder the wire ends to the foil.

(✓) One formed bare wire at L7. Solder the wire ends to the foil.

(✓) Push two ferrite beads onto a 1-1/2" length of #14 bare wire and install at L8. Solder the wire ends to the foil.



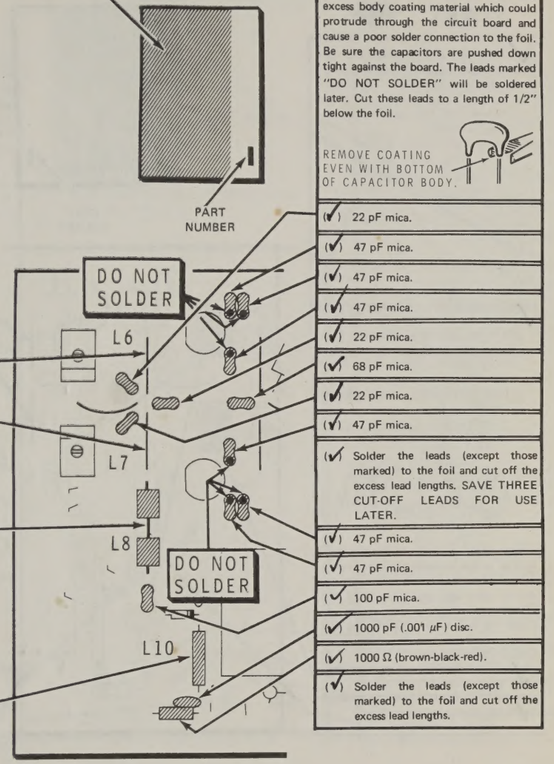
(✓) Coil #45-74 at L10. Bend the leads toward the slot. Solder the wire ends to the foil.



SAFETY WARNING -- Avoid eye injury when you clip off excess leads. We suggest that you wear glasses, or at least clip the leads so the ends will not fly toward your eyes.

(✓) Make sure all leads are soldered to the foil. Cut off the excess lead lengths.

The steps performed in this Pictorial are in this area of the circuit board.



PICTORIAL 1-1

CONTINUE

Before you install a mica or a disc capacitor, remove from its leads any excess body coating material which could protrude through the circuit board and cause a poor solder connection to the foil. Be sure the capacitors are pushed down tight against the board. The leads marked "DO NOT SOLDER" will be soldered later. Cut these leads to a length of 1/2" below the foil.

REMOVE COATING EVEN WITH BOTTOM OF CAPACITOR BODY.

(✓) 22 pF mica.

(✓) 47 pF mica.

(✓) 47 pF mica.

(✓) 47 pF mica.

(✓) 22 pF mica.

(✓) 68 pF mica.

(✓) 22 pF mica.

(✓) 47 pF mica.

(✓) Solder the leads (except those marked) to the foil and cut off the excess lead lengths. SAVE THREE CUT-OFF LEADS FOR USE LATER.

(✓) 47 pF mica.

(✓) 47 pF mica.

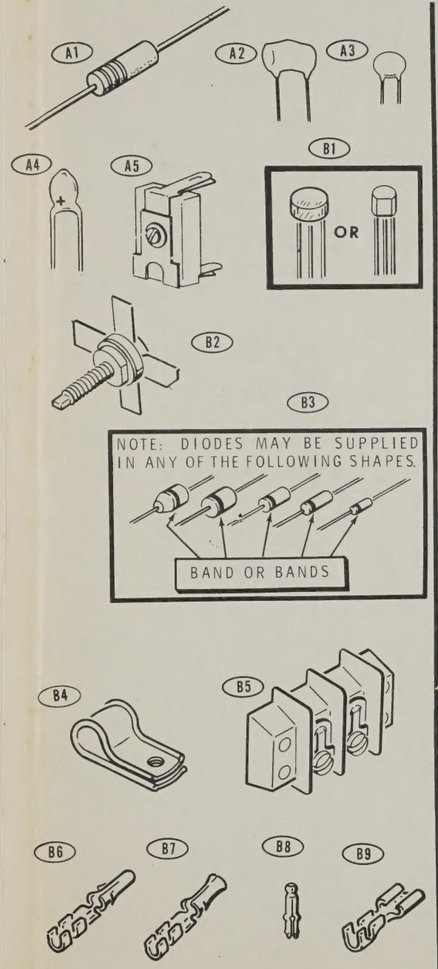
(✓) 100 pF mica.

(✓) 1000 pF (.001 μF) disc.

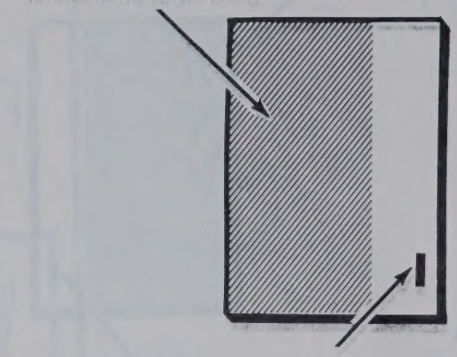
(✓) 1000 Ω (brown-black-red).

(✓) Solder the leads (except those marked) to the foil and cut off the excess lead lengths.

PARTS PICTORIAL

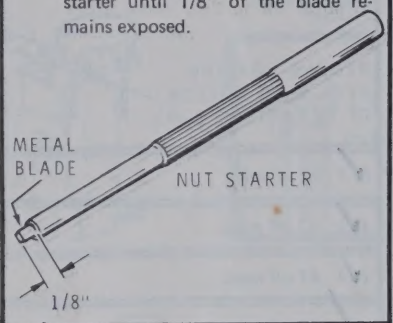


The steps performed in this Pictorial are in this area of the circuit board.

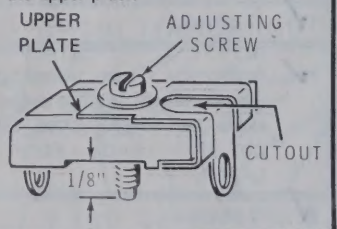


START

(✓) Make an alignment tool for the trimmer capacitors. Use a pair of pliers and push the 1" steel blade into the smaller end of the nut starter until 1/8" of the blade remains exposed.



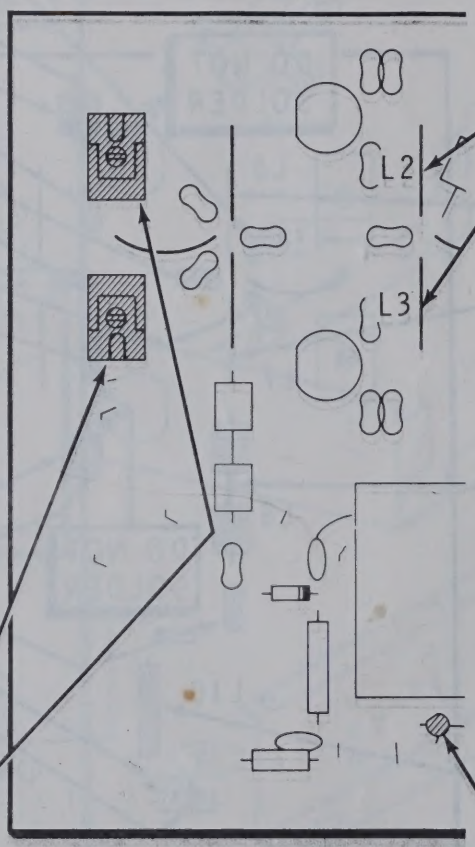
(✓) Turn the adjusting screws of two trimmer capacitors clockwise until you feel resistance. The end of the screw should protrude about 1/8" from the ceramic capacitor body. Note the position of the cutout in the upper plate.



NOTE: In the following steps, make sure the capacitor body is parallel with the circuit board and that the end of the adjusting screw just touches the board. Solder the lugs of each capacitor as it is installed. Be sure to position the upper capacitor plate as shown.

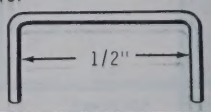
(✓) Trimmer capacitor.

(✓) Trimmer capacitor.



CONTINUE

(✓) Form two 1" lengths of #14 bare wire:

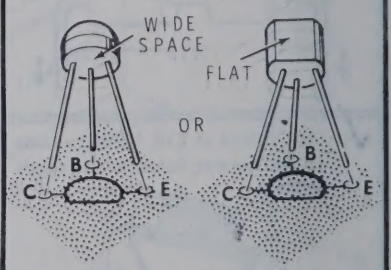


(✓) One formed bare wire at L2. Solder the wire ends to the foil.

(✓) One formed bare wire at L3. Solder the wire ends to the foil.

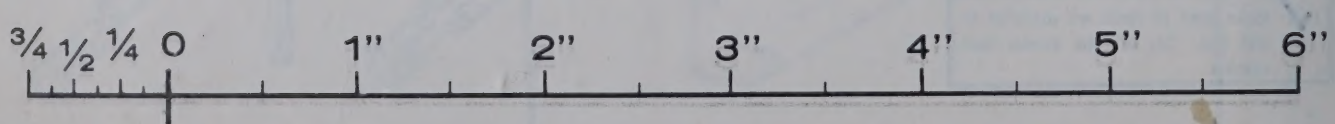
(✓) Cut off the excess lead lengths.

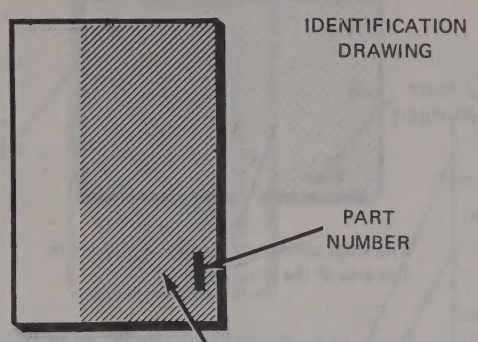
NOTE: To install the transistor in the following step, match the wide space or flat on the transistor body to the outline printed on the circuit board. Then insert the leads into the holes, push the transistor body down to within 1/4" of the circuit board, and solder each lead to the foil. Cut off the excess lead lengths. The transistor may be either one of the two types shown below.



(✓) 2N3641 transistor (#417-155).

PICTORIAL 1-2



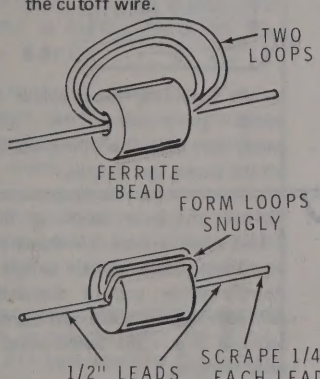


The steps performed in this Pictorial are in this area of the circuit board.

START

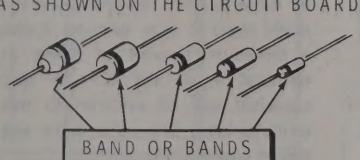
(✓) Thread the length of #24 magnet wire through the remaining ferrite bead twice so there are two complete loops through the bead. Form the loops down against the bead as snugly as possible. Be careful not to damage the wire coating.

(✓) Cut the leads to 1/2". Then scrape 1/4" of the coating from the end of each lead. Use a knife blade. Discard the cutoff wire.



(✓) Ferrite bead at RFC.

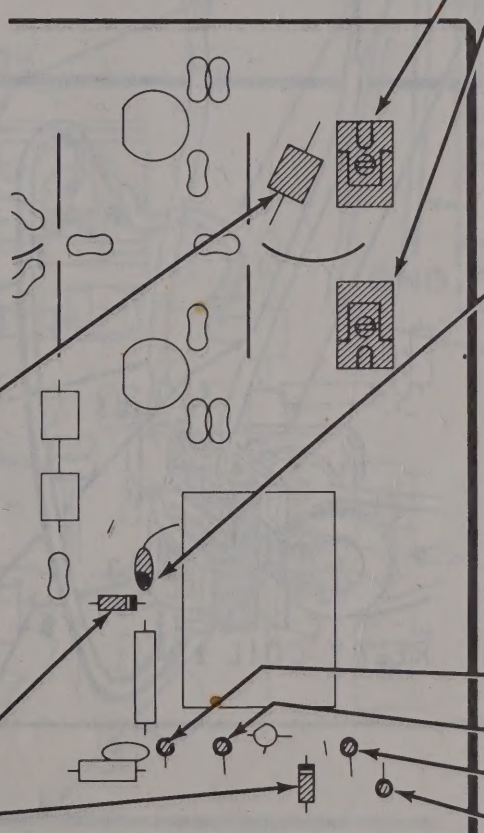
NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



(✓) 1N4149 diode at D1.

(✓) 1N4149 diode at D2.

(✓) Solder all leads to the foil and cut off the excess lead lengths.



CONTINUE

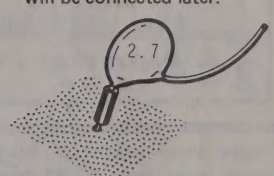
NOTE: Read again the installation instructions for trimmer capacitors in Pictorial 1-2 before performing the following two steps.

(✓) Trimmer capacitor.

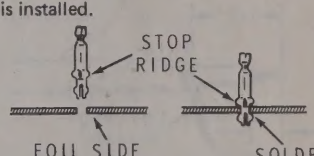
(✓) Trimmer capacitor.

(✓) Cut one lead of a 2.7 pF disc capacitor to 1" and the other lead to 1/2".

(✓) Slide a 3/4" length of sleeving onto the 1" capacitor lead. Place the end of this lead in the hole indicated. Solder it to the foil and cut off any excess lead length. The other lead will be connected later.



NOTE: Install connector pins in the following steps. Solder each pin to the foil as it is installed.



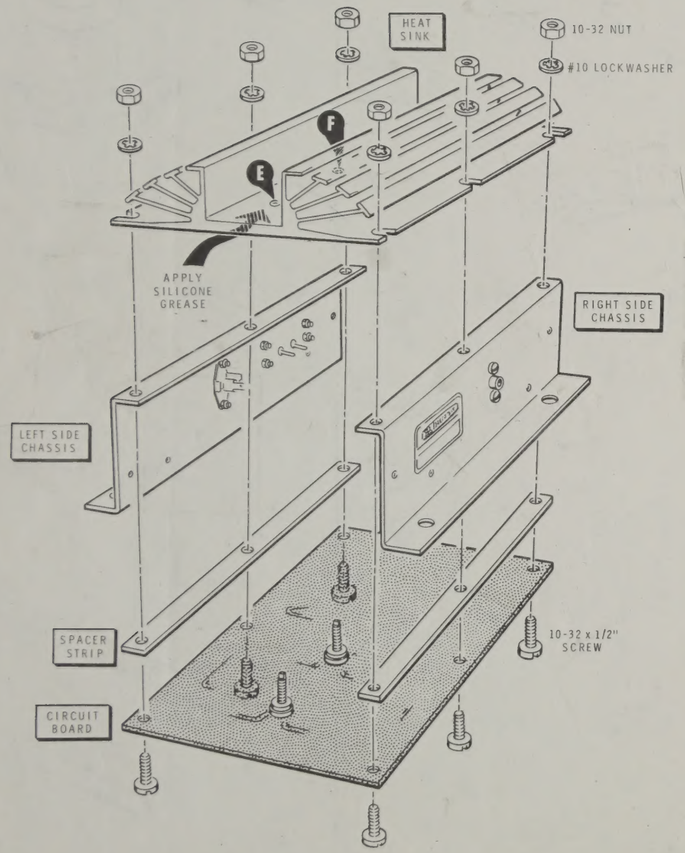
(✓) Connector pin at TP1.

(✓) Connector pin at TP2.

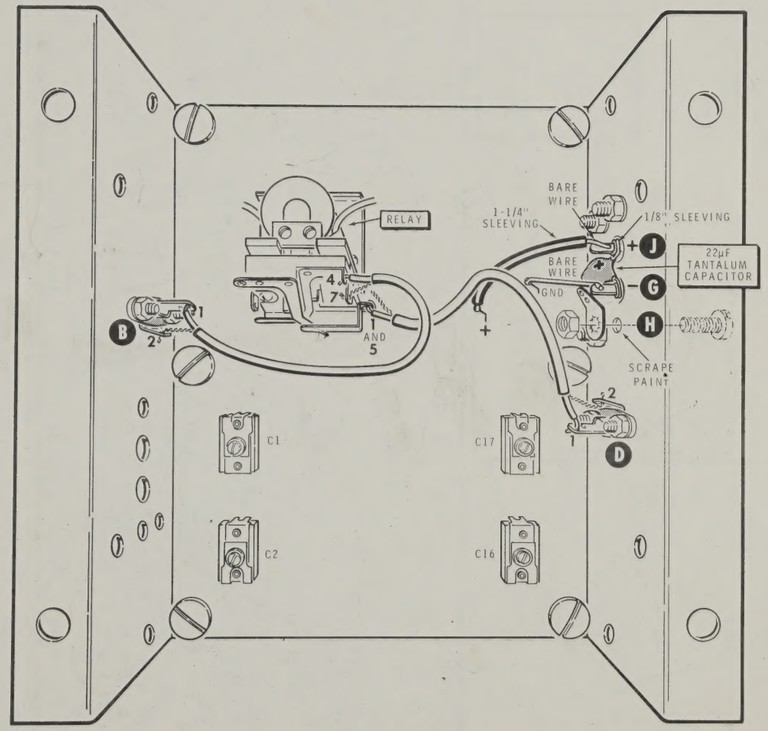
(✓) Connector pin at TP3.

(✓) Connector pin at TP4.

PICTORIAL 1-3



PICTORIAL 2-3



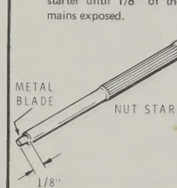
PICTORIAL 2-4

HEATHKIT

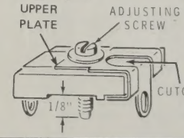
The steps performed in this Pictorial are in this area of the circuit board.

START

- Make an alignment tool for the trimmer capacitors. Use a pair of pliers and push the 1" steel blade into the smaller end of the nut starter until 1/8" of the blade remains exposed.

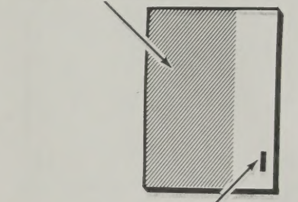


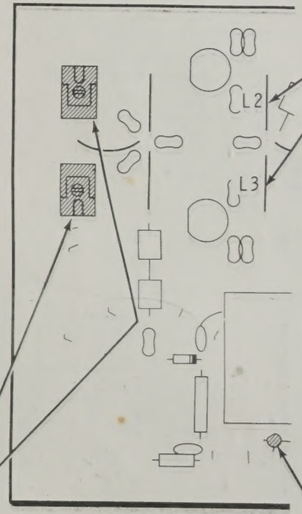
- Turn the adjusting screws of two trimmer capacitors clockwise until you feel resistance. The end of the screw should protrude about 1/8" from the ceramic capacitor body. Note the position of the cutout in the upper plate.



NOTE: In the following steps, make sure the capacitor body is parallel with the circuit board and that the end of the adjusting screw just touches the board. Solder the lugs of each capacitor as it is installed. Be sure to position the upper capacitor plate as shown.

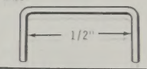
- Trimmer capacitor.
- Trimmer capacitor.





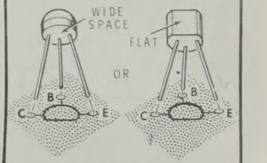
CONTINUE

- Form two 1" lengths of #14 bare wire:



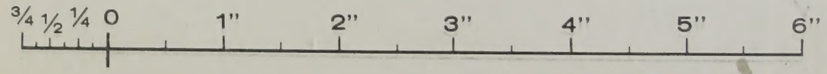
- One formed bare wire at L2. Solder the wire ends to the foil.
- One formed bare wire at L3. Solder the wire ends to the foil.
- Cut off the excess lead lengths.

NOTE: To install the transistor in the following step, match the wide space or flat on the transistor body to the outline printed on the circuit board. Then insert the leads into the holes, push the transistor body down to within 1/4" of the circuit board, and solder each lead to the foil. Cut off the excess lead lengths. The transistor may be either one of the two types shown below.

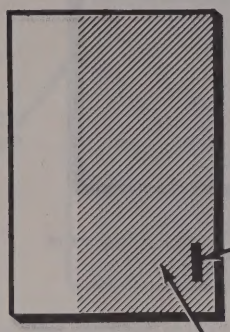


- 2N3641 transistor (#417-155).

PICTORIAL 1-2



IDENTIFICATION DRAWING

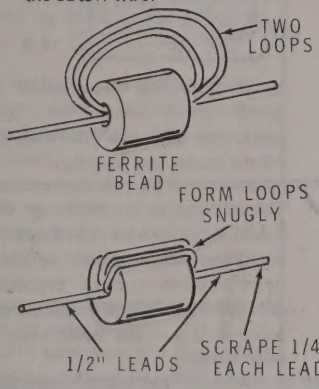


The steps performed in this Pictorial are in this area of the circuit board.

START

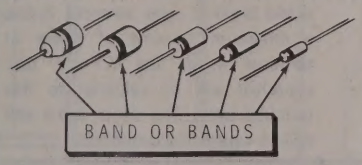
(✓) Thread the length of #24 magnet wire through the remaining ferrite bead twice so there are two complete loops through the bead. Form the loops down against the bead as snugly as possible. Be careful not to damage the wire coating.

(✓) Cut the leads to 1/2". Then scrape 1/4" of the coating from the end of each lead. Use a knife blade. Discard the cutoff wire.



(✓) Ferrite bead at RFC.

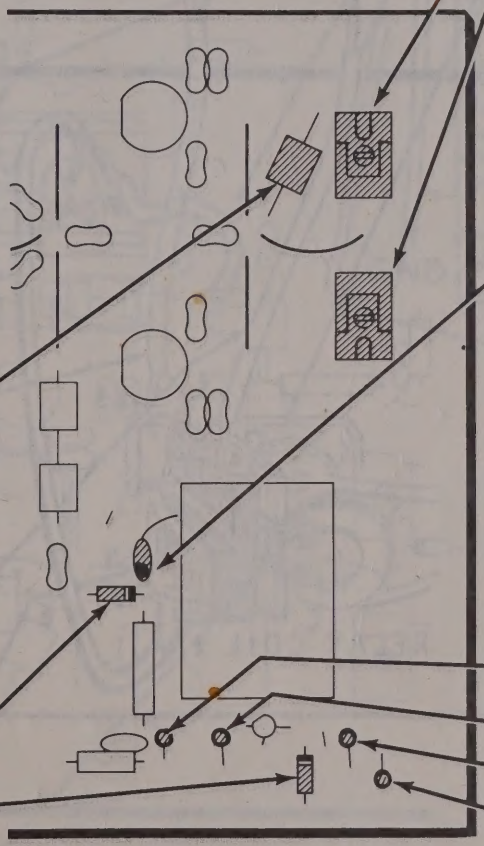
NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.



(✓) 1N4149 diode at D1.

(✓) 1N4149 diode at D2.

(✓) Solder all leads to the foil and cut off the excess lead lengths.



CONTINUE

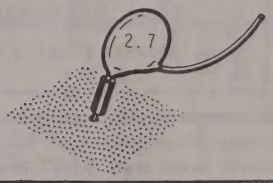
NOTE: Read again the installation instructions for trimmer capacitors in Pictorial 1-2 before performing the following two steps.

(✓) Trimmer capacitor.

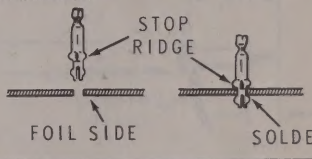
(✓) Trimmer capacitor.

(✓) Cut one lead of a 2.7 pF disc capacitor to 1" and the other lead to 1/2".

(✓) Slide a 3/4" length of sleeving onto the 1" capacitor lead. Place the end of this lead in the hole indicated. Solder it to the foil and cut off any excess lead length. The other lead will be connected later.



NOTE: Install connector pins in the following steps. Solder each pin to the foil as it is installed.



(✓) Connector pin at TP1.

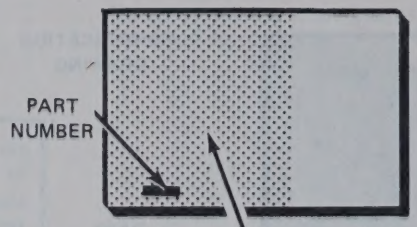
(✓) Connector pin at TP2.

(✓) Connector pin at TP3.

(✓) Connector pin at TP4.

PICTORIAL 1-3

IDENTIFICATION DRAWING

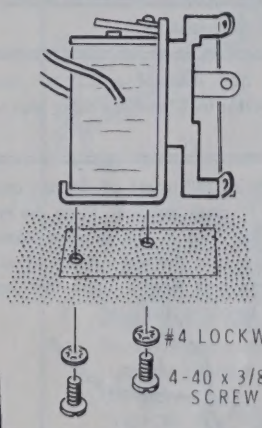


The steps performed in this Pictorial are in this area of the circuit board.

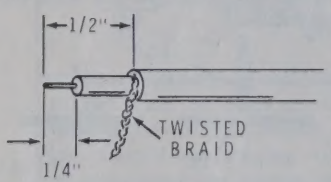
START

NOTE THE CHANGE IN CIRCUIT BOARD POSITION.

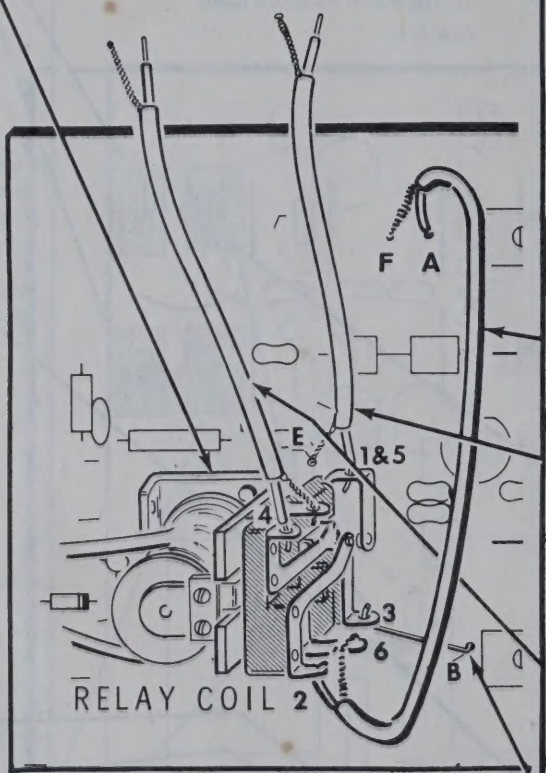
(✓) Relay at 69-70. Use 4-40 screws and #4 lockwashers. Be sure to position the relay coil as shown.



(✓) Prepare three lengths of RG-174 coaxial cable (two 3-3/4" lengths and one 4" length). Prepare both ends of each cable as follows:



1. Remove 1/2" of the outer insulation.
2. Use a pointed object and comb out the braided shield wires.
3. Twist the shield wires into a small, tight point.
4. Remove 1/4" of insulation from the inner conductor.
5. Melt a small amount of solder on the twisted braid and on the inner conductor.

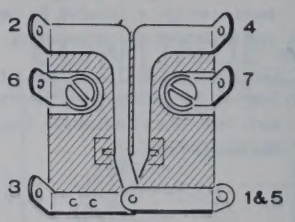


PICTORIAL 1-4

CONTINUE

NOTE:

1. The following sketch identifies the relay terminals, which may be either straight or bent.



2. In the following steps, solder the shield braid and the inner conductors as they are installed. Cut off the excess lead lengths.

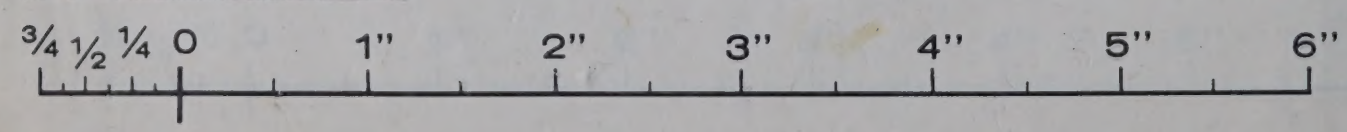
(✓) Connect the inner conductor of a 3-3/4" cable to hole A in the circuit board and the shield braid to hole F. At the other end of the cable, connect the inner conductor to relay terminal 2 and the shield braid to relay terminal 6.

(✓) Connect the inner conductor of a 3-3/4" cable to relay terminal 1 and 5 and the shield braid to hole E. The other end will be connected later.

(✓) Connect the inner conductor of the 4" cable to relay terminal 4 and the shield braid to relay terminal 7. Use a minimum amount of solder at terminal 4, as the 2.7 pF disc capacitor will be soldered to this terminal later. The other cable end will be connected later.

(✓) Connect one of the capacitor leads laid aside earlier between relay terminal 3 and hole B in the circuit board. Solder the wire ends and cut off the excess length.

(✓) Carefully inspect the coaxial cable connections to make sure the shield braid is not touching any unintended metal and that there are no fine strands of shield braid wire (sometimes almost invisible) causing a short circuit.



START

NOTE THE CHANGE IN THE CIRCUIT BOARD POSITION.

(✓) Cut a 1-3/4" and a 2" length of #14 bare wire. Lay these wires aside for use later.

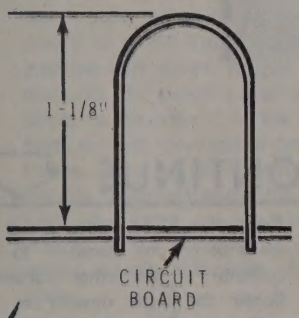
(✓) Cut the remaining #14 bare wire into two equal lengths for use in forming inductors L1 and L9 in the following steps.

NOTE: In the following two steps, you must form #14 bare wire so it exactly covers the drawing for each inductor. The wire length is critical at the frequencies covered by this Amplifier. Be careful when you form and install the inductors. The ends of nut drivers, or similar objects, may prove useful as bending forms for the inductors.

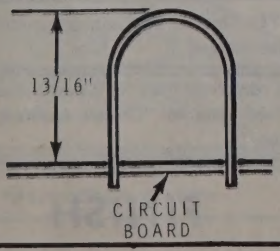
Although illustrated differently to show their location, the two inductors must be installed perpendicular (at right angles) to the circuit board.

Before forming the heavy wire, you may wish to remove bends by drawing it back and forth around a sharp corner, such as a workbench edge.

(✓) Form an inductor from one of the two #14 bare wires and mount it at L1 to the dimensions shown. Bend the wire in the middle. Solder the leads to the foil and cut off the excess lead lengths.



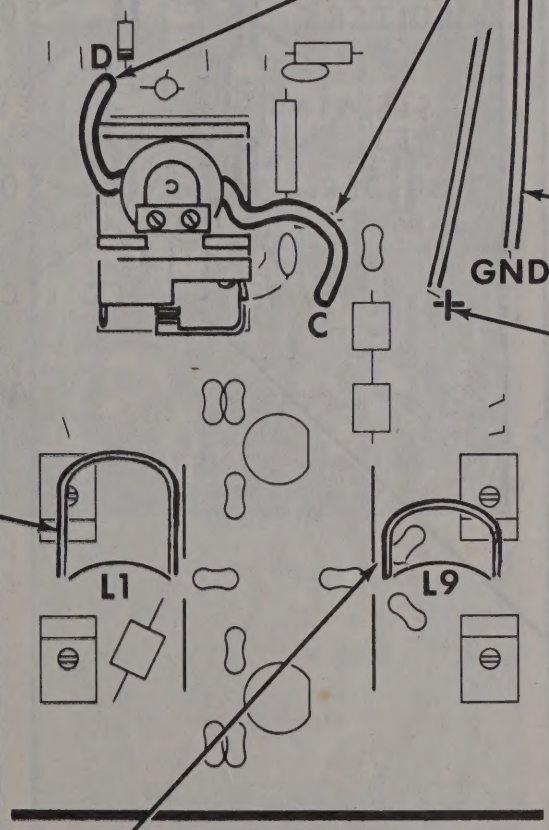
(✓) Form an inductor from the other #14 bare wire and mount it at L9 to the dimensions shown. Bend the wire in the middle. Solder the leads to the foil and cut off excess lead lengths.



IDENTIFICATION DRAWING

PART NUMBER

The steps performed in this Pictorial are in this area of the circuit board.

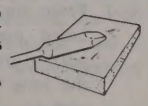


CONTINUE

(✓) Connect one of the relay coil leads to hole D.

(✓) Connect the other relay coil lead to hole C. Pass this lead around the coaxial cable coming from relay terminal 1 and 5.

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN... WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



(✓) Solder the leads to the foil and cut off excess lead lengths.

NOTE: In the following two steps, the wires should not protrude more than 1/8" below the foil when you solder them.

(✓) Solder a 2" #14 bare wire to hole GND.

(✓) Solder a 1-3/4" #14 bare wire to hole +.

PICTORIAL 1-5

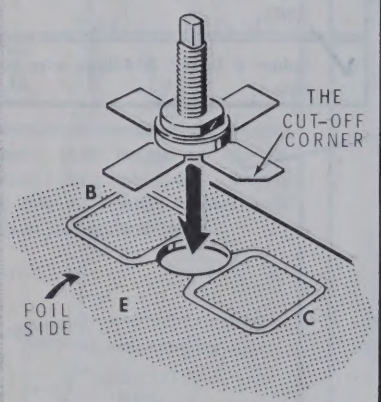
START

IMPORTANT: If the two power transistors furnished (part #417-299) are type 2N5591, install them as shown in this Pictorial. If the transistors furnished are type CTC B25-12, follow the steps on Page 11 and disregard this page.

(✓) Turn the circuit board foil-side-up so the board part number is in the position shown.

CAUTION: Handle power transistors, particularly the studs, with care.

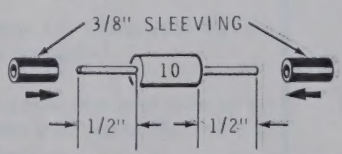
( ) From the foil side of the circuit board, place the round, white, top portion of a 2N5591 transistor into the hole shown. Position the lead with the cut-off corner so it points to the letter C in the foil. Form the leads down against the foil for as much of their length as possible. Solder each lead to the foil. Carry the solder up as close as possible to the transistor body to reduce the effective length of the leads.



(✓) 2N5591 transistor, installed as in the preceding step.

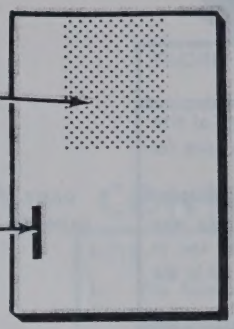
(✓) Solder the six capacitor leads which were not soldered earlier. Cut off the excess lead lengths.

(✓) Cut the leads of two 10 Ω resistors to 1/2". Place a 3/8" length of sleeving on each lead.

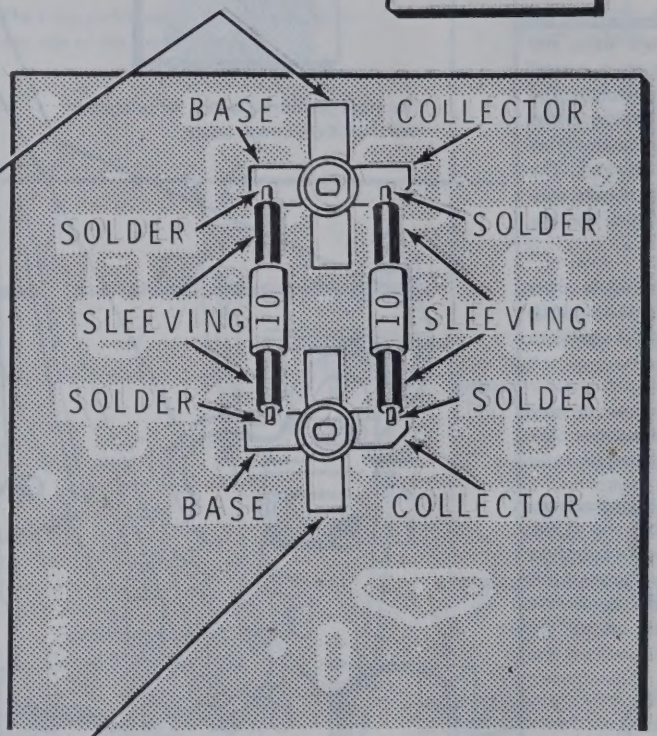


(✓) Connect a 10 Ω resistor from the base of one transistor to the base of the other transistor. Solder the leads directly to the base leads.

The steps performed in this Pictorial are in this area of the circuit board.



IDENTIFICATION DRAWING



PICTORIAL 1-6

CONTINUE

(✓) Connect a 10 Ω resistor from the collector of one transistor to the collector of the other transistor. Solder the leads directly to the collector leads.

(✓) Inspect the circuit boards carefully to make sure the sleeving completely covers the resistor leads except over the leads where they are connected.

NOTE: One or two connector pins may remain unused.

This completes the circuit board assembly. Proceed now to "Chassis Assembly and Wiring."

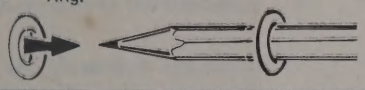
FINISH

START

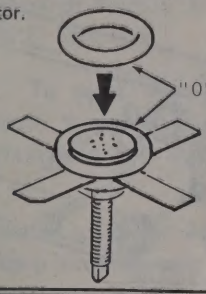
IMPORTANT: Follow this Pictorial ONLY if you were furnished two type CTC B25-12 power transistors (part #417-299).

CAUTION: Handle power transistors, particularly the studs, with care.

( ) Stretch a white "0" ring by rolling it onto a round object such as a pencil. Repeat this action two or three times to stretch the "0" ring the maximum amount. Then remove the ring.

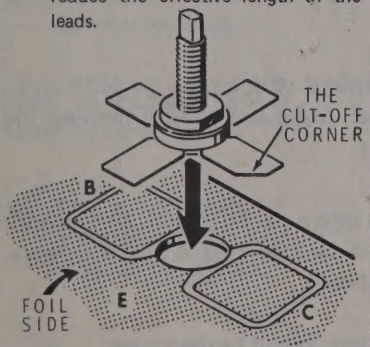


( ) Carefully stretch the "0" ring onto the round, white top of the transistor.



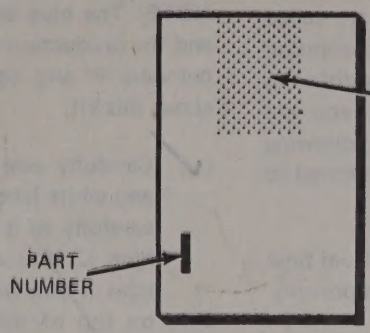
( ) Turn the circuit board foil-side-up so the board part number is in the position shown.

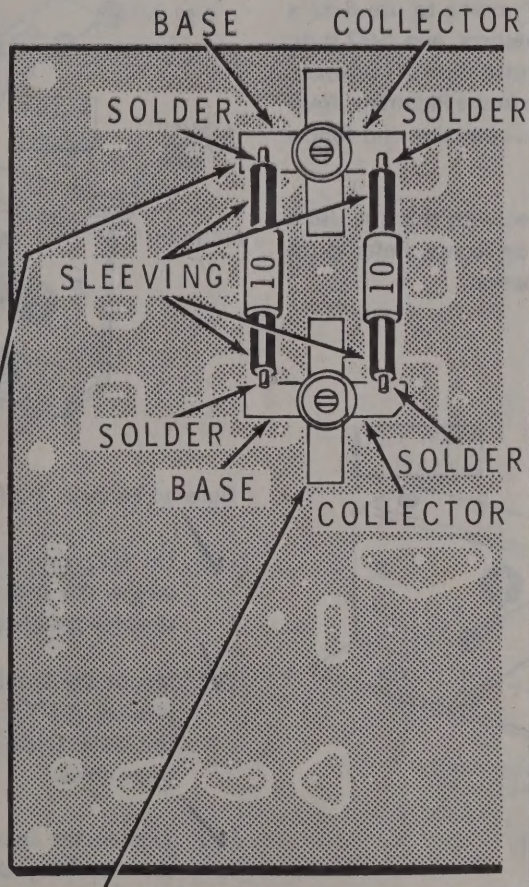
( ) From the foil side of the circuit board, place the round, white, top portion of a CTC B25-12 transistor into the hole shown. Position the lead with the cut-off corner so it points to the letter C in the foil. Form the leads down against the foil for as much of their length as possible. Solder each lead to the foil. Carry the solder up as close as possible to the transistor body to reduce the effective length of the leads.



( ) CTC B25-12 transistor installed as in the preceding instructions.

IDENTIFICATION DRAWING





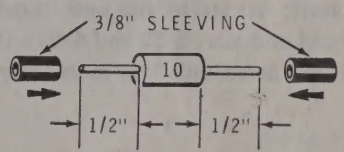
PICTORIAL 1-7

CONTINUE

( ) After each transistor is soldered in place, remove and discard the "0" ring from each transistor. Use a darning needle, or similar pointed object.

( ) Solder the six capacitor leads which were not soldered earlier. Cut off the excess lead lengths.

( ) Cut the leads of two 10 Ω resistors to 1/2". Place a 3/8" length of sleeving on each lead.



( ) Connect a 10 Ω resistor from the base of one transistor to the base of the other transistor. Solder the leads directly to the base leads.

( ) Connect a 10 Ω resistor from the collector of one transistor to the collector of the other transistor. Solder the leads directly to the collector leads.

( ) Inspect the circuit boards carefully to make sure the sleeving completely covers the resistor leads except over the leads where they are connected.

NOTE: One or two connector pins may remain unused.

This completes the circuit board assembly. Proceed now to "Chassis Assembly and Wiring."

FINISH

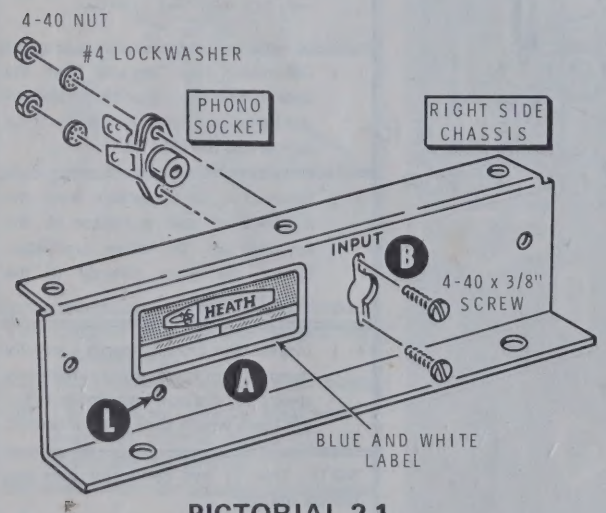
CHASSIS ASSEMBLY AND WIRING

The illustrations in this section of the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps. Details are used in addition to the Pictorials to illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

Look at the "Chassis Photographs" (on Page 28) from time to time to see the actual positions of wires and components.

Lockwashers and nuts will be used with most screws when you are mounting parts. Therefore, many steps will call out only the size and type of hardware used. For example, the phrase "Use 6-32 x 1/4" hardware" means to use 6-32 x 1/4" screws, one or more #6 lockwashers, and 6-32 nuts. Refer to the Details for the proper installation of hardware. Be sure to position the parts as shown in the Pictorials. Read the entire step before performing the operation and follow the instructions carefully.

A plastic nut starter has been provided with this kit. Use it to hold and start 6-32 and 4-40 nuts on screws. Refer to the "Kit Builders Guide" for more information.



PICTORIAL 2-1

Refer to Pictorial 2-1 for the following steps.

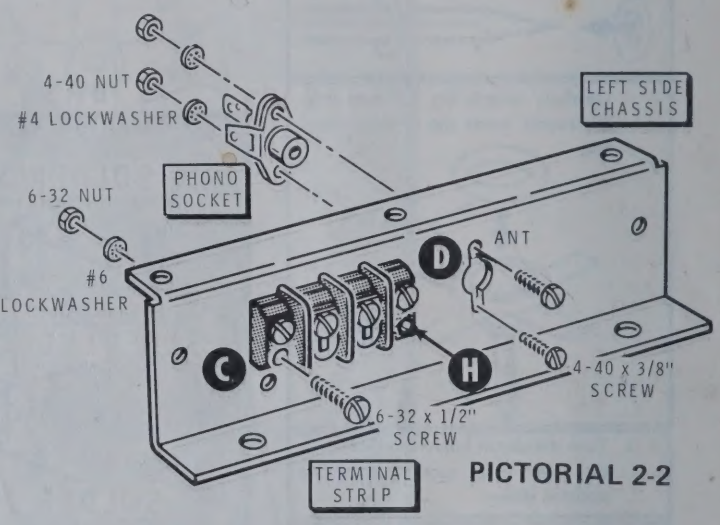
(✓) On the inside of the chassis, scrape the paint from around the slots at B.

(✓) Insert a phono plug into a phono socket. Then mount the phono socket at B on the right side chassis (printed "INPUT"). Use 4-40 x 3/8" hardware. Use the nut starter to start the nuts on the screws.

(✓) Remove the phono plug. It will be used later.

NOTE: The blue and white label shows the model number and the production series number of your kit. Refer to these numbers in any communications to the Heath Company about this kit.

(✓) Carefully peel away the backing paper from the blue and white label. Then install the label at A. Position it carefully so it covers the six holes but does NOT cover hole L. You will avoid smearing the numbers on the label if you will put the piece of waxed backing paper on top of the label and then rub on it instead of directly on the label.



PICTORIAL 2-2

Refer to Pictorial 2-2 for the following steps.

(✓) On the inside of the left side chassis (printed "ANT"), scrape the paint from around hole H and from the slots for the phono socket at D.

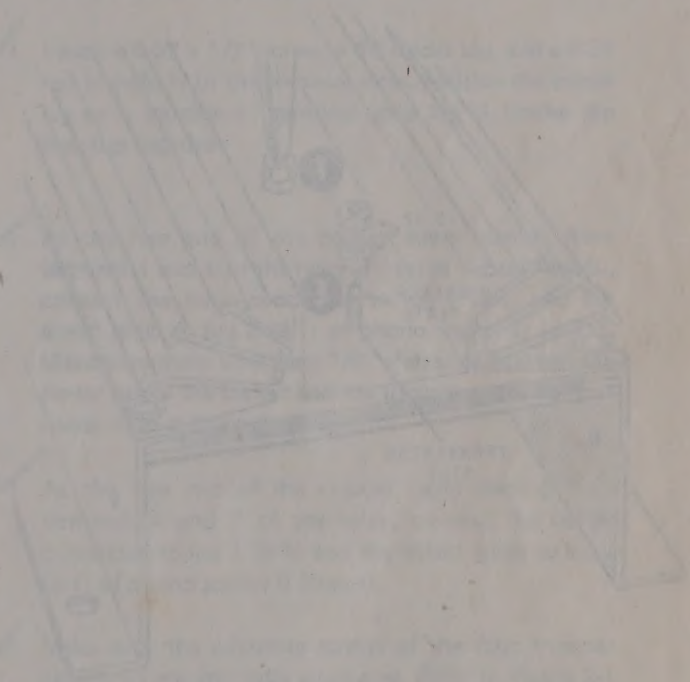
(✓) Mount the terminal strip at C on the left side chassis, printed "ANT." DO NOT install a screw in hole H at this time. Use 6-32 x 1/2" hardware at the remaining three holes.

(✓) Tighten the two terminal strip screws (in addition to the mounting screws). Make sure the (+) terminal lug is centered in its hole.

(✓) Insert a phono plug into a phono socket. Then mount the phono socket at D. Use 4-40 x 3/8" hardware. Position the lugs as shown.

(✓) Remove the phono plug. It will be used later.

Refer to Pictorial 2-3 (fold-out from Page 6) for the following steps.



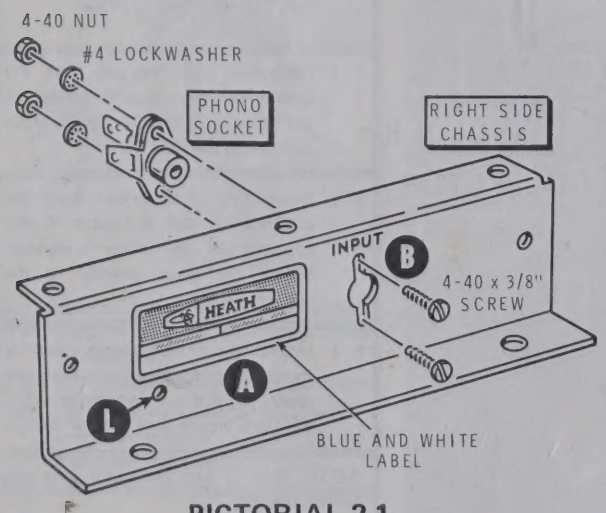
CHASSIS ASSEMBLY AND WIRING

The illustrations in this section of the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps. Details are used in addition to the Pictorials to illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

Look at the "Chassis Photographs" (on Page 28) from time to time to see the actual positions of wires and components.

Lockwashers and nuts will be used with most screws when you are mounting parts. Therefore, many steps will call out only the size and type of hardware used. For example, the phrase "Use 6-32 x 1/4" hardware" means to use 6-32 x 1/4" screws, one or more #6 lockwashers, and 6-32 nuts. Refer to the Details for the proper installation of hardware. Be sure to position the parts as shown in the Pictorials. Read the entire step before performing the operation and follow the instructions carefully.

A plastic nut starter has been provided with this kit. Use it to hold and start 6-32 and 4-40 nuts on screws. Refer to the "Kit Builders Guide" for more information.



PICTORIAL 2-1

Refer to Pictorial 2-1 for the following steps.

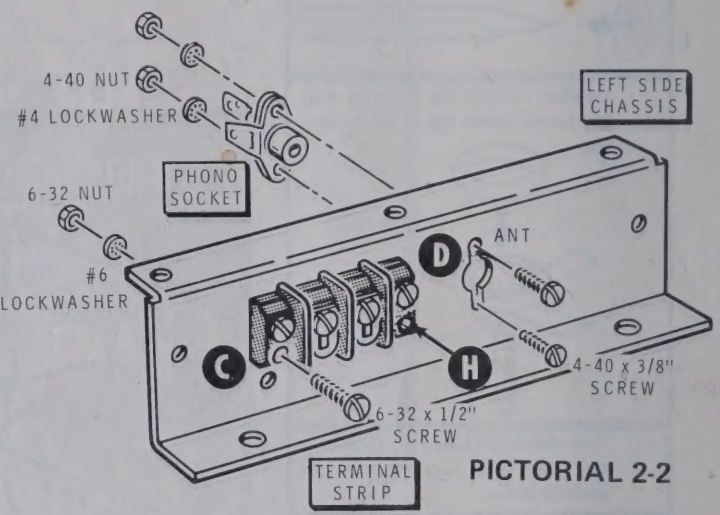
(✓) On the inside of the chassis, scrape the paint from around the slots at B.

(✓) Insert a phono plug into a phono socket. Then mount the phono socket at B on the right side chassis (printed "INPUT"). Use 4-40 x 3/8" hardware. Use the nut starter to start the nuts on the screws.

(✓) Remove the phono plug. It will be used later.

NOTE: The blue and white label shows the model number and the production series number of your kit. Refer to these numbers in any communications to the Heath Company about this kit.

(✓) Carefully peel away the backing paper from the blue and white label. Then install the label at A. Position it carefully so it covers the six holes but does NOT cover hole L. You will avoid smearing the numbers on the label if you will put the piece of waxed backing paper on top of the label and then rub on it instead of directly on the label.



PICTORIAL 2-2

Refer to Pictorial 2-2 for the following steps.

(✓) On the inside of the left side chassis (printed "ANT"), scrape the paint from around hole H and from the slots for the phono socket at D.

(✓) Mount the terminal strip at C on the left side chassis, printed "ANT." DO NOT install a screw in hole H at this time. Use 6-32 x 1/2" hardware at the remaining three holes.

(✓) Tighten the two terminal strip screws (in addition to the mounting screws). Make sure the (+) terminal lug is centered in its hole.

(✓) Insert a phono plug into a phono socket. Then mount the phono socket at D. Use 4-40 x 3/8" hardware. Position the lugs as shown.

(✓) Remove the phono plug. It will be used later.

Refer to Pictorial 2-3 (fold-out from Page 6) for the following steps.

( ) Smear silicone grease around holes E and F on the flat side of the heat sink. Open the grease pod by cutting off its corner as shown in the inset drawing and squeeze the grease out. CAUTION: Keep this grease out of your eyes and off your clothes. Wash your fingers clean.

NOTE: In the following step, hardware installation may be easier if you position the assembly on one end and install the top screw in each row first. Insert the screw, place the lockwasher, and then hold the nut on the end of the screw with needle-nose pliers as you turn the screw with a screwdriver. Take care not to put any strain on the transistor studs during the following assembly.

( ) Assemble the circuit board, the right side chassis, the left side chassis, the spacer strips, and the heat sink. Position the heat sink so the transistor studs fit through holes E and F of the heat sink. Use 10-32 x 1/2" hardware.

NOTE: To avoid damage to the power transistors, it is important that you follow exactly the instructions for tightening the nuts in the following steps:

( ) Refer to Detail 2-3A and start ONE 8-32 nut onto each transistor stud at E and F.

( ) Use your fingers ONLY and tighten the two nuts as much as possible.

( ) Hold the wrench flats on the end of the transistor stud with pliers to keep the transistor stud from turning. Then tighten each transistor mounting nut 1/8 turn more with the end wrench furnished.

( ) Start a second 8-32 nut onto each transistor stud. Hold the wrench flats with pliers, as before, and tighten the second nuts down against the first ones to serve as locknuts.

Refer to Pictorial 2-4 (fold-out from Page 6) for the following steps.

( ) Cut a 1/8" length of sleeving and slide it as far as possible onto (+) terminal strip lug J so this lug cannot short to the chassis.

( ) Connect the + lead of the 22 μF tantalum capacitor to terminal strip lug J (NS). Connect the other lead to terminal strip lug G (NS).

CAUTION: To avoid damage to the circuit board as you form the bare wires in the following steps, hold the wire with thin nose pliers at the surface of the board whenever you bend the wire. The pliers will then take the bending force instead of the circuit board.

( ) Form the bare wire coming from GND on the circuit board so it touches (–) terminal strip lug G (S-2). Cut off any excess wire.

( ) Slide a 1-1/4" length of sleeving onto the bare wire coming from + on the circuit board.

( ) Form this bare wire so it touches (+) terminal strip lug J (S-2). Cut off any excess wire.

( ) Install a 6-32 x 1/2" screw, a #6 solder lug, and a 6-32 nut in hole H in the terminal strip. Position the solder lug so it touches (-) terminal strip lug G. Solder the two lugs together.

( ) At the free end of the coaxial cable coming from terminal 1 and 5 of the relay (Pictorial 1-4 on Page 8), connect the inner conductor to lug 1 (S-1) and the shield braid to lug 2 (S-1) of phono socket D (ANT). Make sure there is at least 1/8" clearance between the center lug of the socket and the trimmer capacitor just below it on the circuit board.

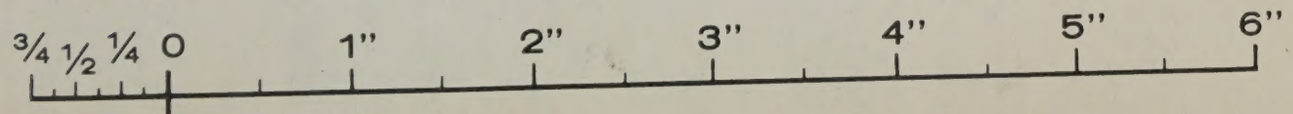
( ) At the free end of the coaxial cable coming from terminals 4 and 7 of the relay, connect the center conductor to lug 1 (S-1) and the shield wires to lug 2 (S-1) of phono socket B (Input).

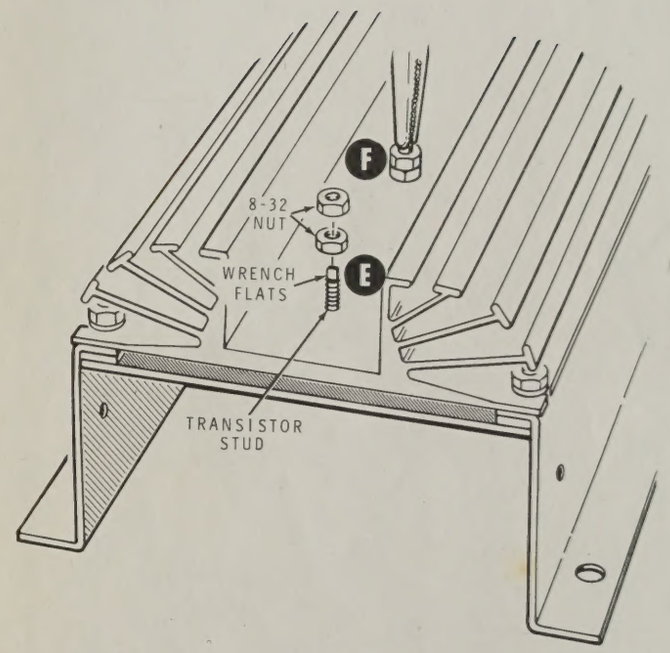
( ) Make sure the adjusting screws of the four trimmer capacitors are still fully clockwise. Refer to Figure 2-1 (fold-out from Page 17) and turn each counterclockwise as follows:

C1	1-1/4 turn
C2	1-1/4 turn
C16	1/2 turn
C17	1-1/4 turn

NOTE: One lead of the 2.7 pF disc capacitor remains unsoldered at this time.

This completes the "Step-by-Step Assembly" of your Heathkit 2-Meter FM Amplifier. Carefully inspect all connections. Shake out any wire clippings or solder splashes. Look between the circuit board and the heat sink to make sure there are no uncut wires or lugs which could cause a short circuit. Then proceed to "Installation and Alignment."





Detail 2-3A

INSTALLATION AND ALIGNMENT

Refer to Figure 2-1 (fold-out from Page 19) for the location of parts of the Amplifier mentioned in these instructions.

RESISTANCE CHECKS

	ONE LEAD	OTHER LEAD	RELAY#	OHMS*
1.	ANT	INPUT	UP	0
2.	ANT	INPUT	DOWN	∞
3.	ANT	Relay term. #2	UP	∞
4.	ANT	Relay term #2	DOWN	0
5.	+	L7	UP	0
6.	+	Lead of L8, adjacent to hole C	UP	0

Figure 2-2

* ∞ = Infinity (full scale)

\# DOWN means to push down on the relay armature to place the relay in the transmit position. The UP position is the receive position.

RESISTANCE CHECKS (Figure 2-2)

Set your ohmmeter on the R x 1 scale and make the resistance checks in the above chart. If the readings are not those shown in the chart, find and correct the difficulty before proceeding. Try reversing the meter leads.

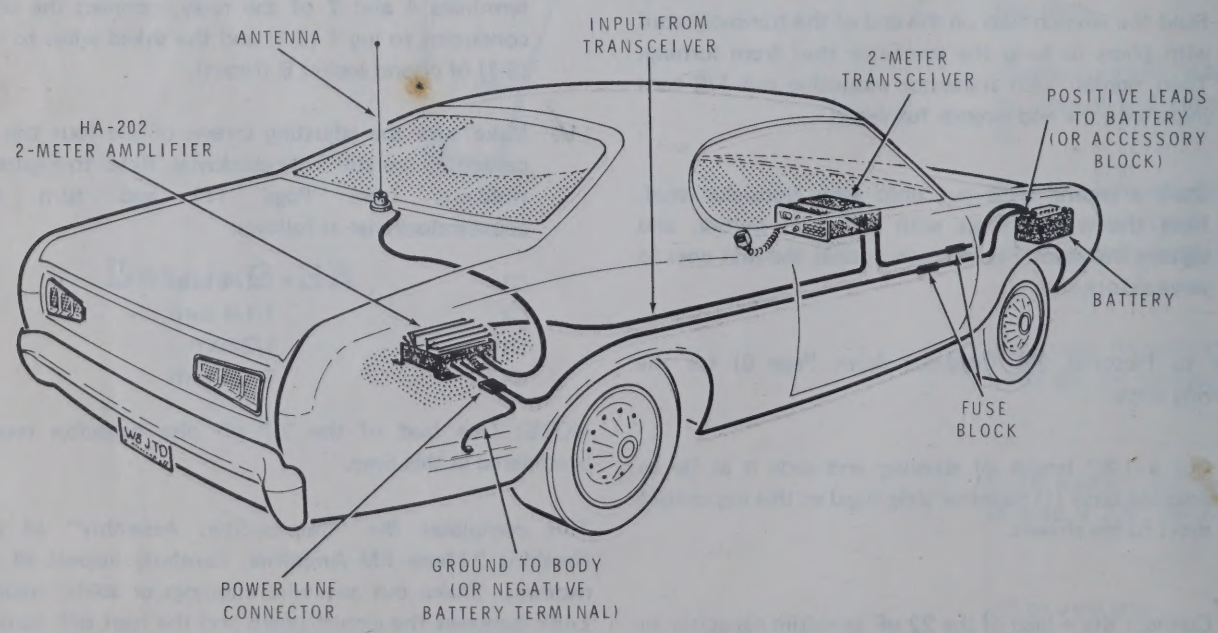
INSTALLATION

Refer to the "Installation X-Ray View" for the suggested arrangement of components and their interconnections.

All installation steps will be accomplished before your 2-Meter FM Amplifier is aligned, except for installing the amplifier cover and securing the completed Amplifier in place.

In the absence of excitation, this Amplifier draws less than one mA of current and on-off switching is therefore not required.

Although the standard installation instructions suggest connecting the power wire to a fuse near the battery, it is possible that there is an unused circuit available on the accessory fuse block of your automobile. Such a circuit normally has provision for a fuse, and in this case the red power wire can be connected to this unused terminal. (A 1/4" push-on connector is furnished. Any other type of connector required should be purchased locally.) The automobile ignition switch will usually control this circuit in the same manner as the other accessory circuits.



Installation X-Ray View

Low power operation can be secured in two ways. First, you can reduce the excitation below 1-1/2 watts, which is below the pull-in point of the amplifier relay. Second, you can connect a single-pole switch in series with the red power wire to prevent the Amplifier from turning on. Straight-through operation will result.

( ) Decide where the Amplifier will be installed. It should be located as close to the antenna as convenient.

( ) Mark the mounting holes for the Amplifier. Use the Amplifier assembly as a template.

( ) Drill the mounting holes with a #21 or a 5/32" drill bit. 10-32 sheet metal screws will be used to mount the Amplifier later.

Transmission Lines

( ) Carefully measure the lengths of transmission line required between the exciter and the Amplifier, and between the Amplifier and the antenna. Cut the RG-58A/U coaxial cable to the measured lengths.

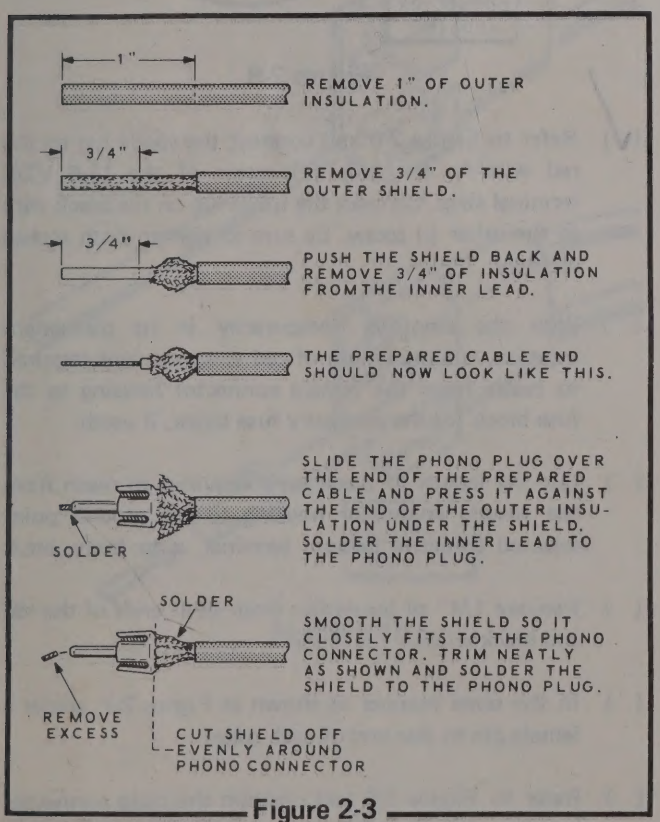

1"
REMOVE 1" OF OUTER INSULATION.
3/4"
REMOVE 3/4" OF THE OUTER SHIELD.
3/4"
PUSH THE SHIELD BACK AND REMOVE 3/4" OF INSULATION FROMTHE INNER LEAD.
THE PREPARED CABLE END SHOULD NOW LOOK LIKE THIS.
SOLDER
SLIDE THE PHONO PLUG OVER THE END OF THE PREPARED CABLE AND PRESS IT AGAINST THE END OF THE OUTER INSULATION UNDER THE SHIELD. SOLDER THE INNER LEAD TO THE PHONO PLUG.
SOLDER
REMOVE EXCESS
CUT SHIELD OFF EVENLY AROUND PHONO CONNECTOR
SMOOTH THE SHIELD SO IT CLOSELY FITS TO THE PHONO CONNECTOR. TRIM NEATLY AS SHOWN AND SOLDER THE SHIELD TO THE PHONO PLUG.

Figure 2-3

( ) Refer to Figure 2-3 and install one of the two phono plugs furnished on one end of each cable. To avoid an impedance mismatch in the transmission line, be sure to install the plugs as shown.

Power Lines

( ) Refer to Figure 2-4 and install the fuse block close to the battery. Use a #6 x 3/8" sheet metal screw in a hole made with a #35 or a 7/64" drill bit.

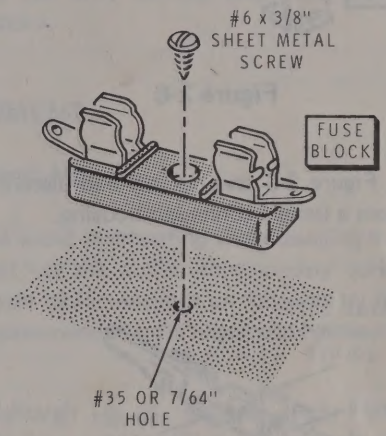


Figure 2-4

( ) Cut a length of red stranded wire to reach from the fuse block to the battery positive terminal. Solder one end of this wire to the fuse block. DO NOT connect the free end until instructed to do so.

( ) Install the fuse in the clips on the fuse block.

(✓) Cut a 12" length of black stranded wire and a 12" length of red stranded wire. Remove 1/4" of insulation from both ends of each wire.

(✓) Refer to Figure 2-5 and install a spade lug on one end of each wire.

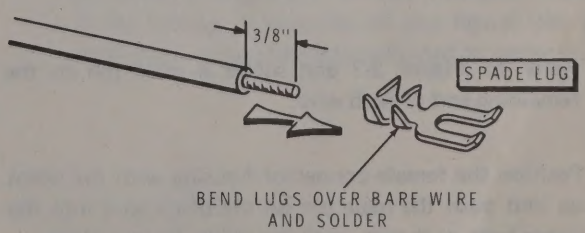
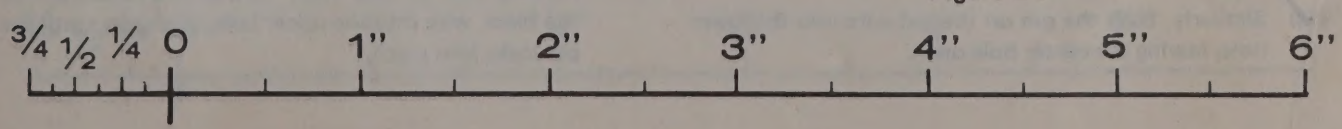


Figure 2-5



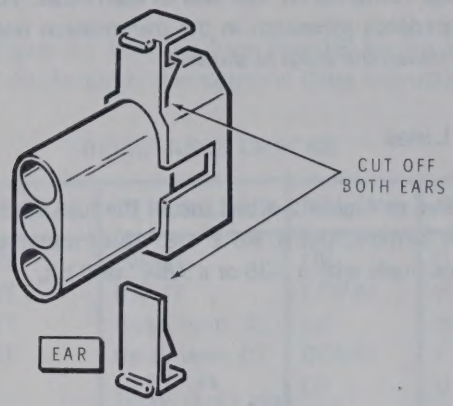


Figure 2-6

(✓) Refer to Figure 2-6 and cut off and discard the two "ears" from a female connector housing.

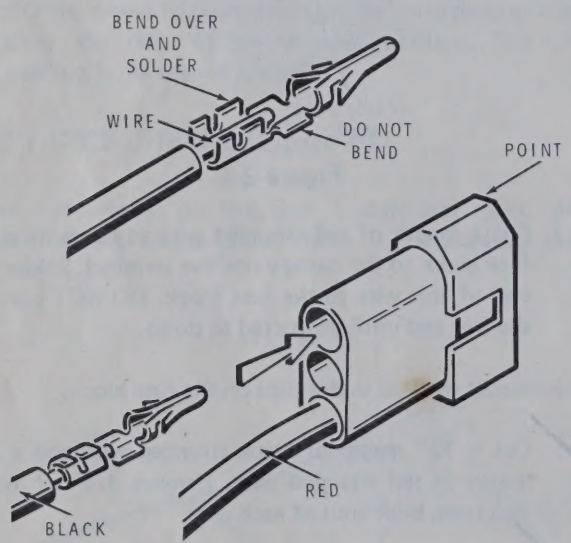


Figure 2-7

(✓) Refer to Figure 2-7 and solder a male pin to the remaining end of each wire.

(✓) Position the female connector housing with the point up and push the male pin on the black wire into the upper hole, as shown, until the pin locks into place.

(✓) Similarly, push the pin on the red wire into the lower hole, leaving the center hole open.

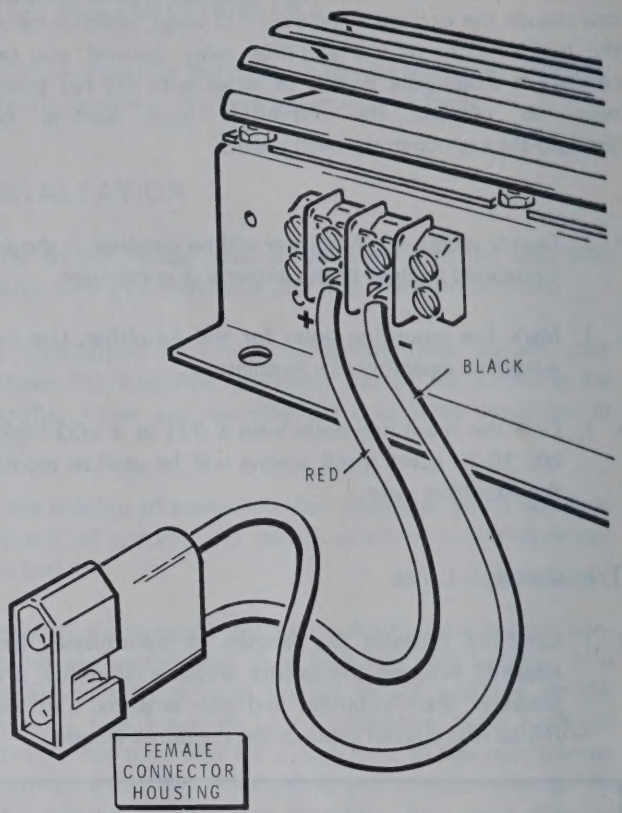


Figure 2-8

(✓) Refer to Figure 2-8 and connect the spade lug on the red wire to the plus (+) screw of the 13.6 VDC terminal strip. Connect the spade lug on the black wire to the other (-) screw. Be sure to tighten both screws securely.

( ) With the amplifier temporarily in its permanent location, cut the length of red stranded wire required to reach from the female connector housing to the fuse block (or the accessory fuse block, if used).

( ) Cut the length of black wire required to reach from the female connector housing to the ground point selected (negative battery terminal, auto body, etc.).

( ) Remove 1/4" of insulation from both ends of the red and black wires.

( ) In the same manner as shown in Figure 2-7, solder a female pin to one end of each wire.

( ) Refer to Figure 2-9 and position the male connector housing with the point up and push the female pin on the black wire into the upper hole, as shown, until the pin locks into place.

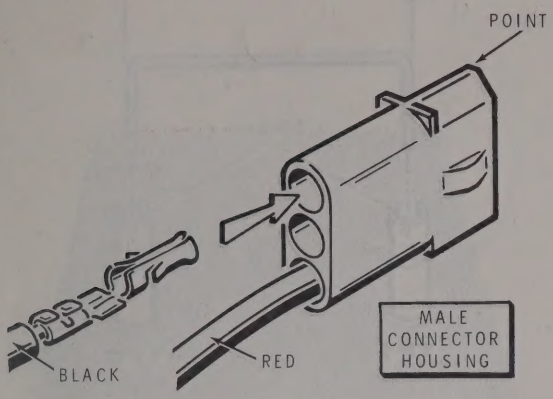


Figure 2-9

( ) Similarly, push the pin on the red wire into the lower hole, leaving the center hole open.

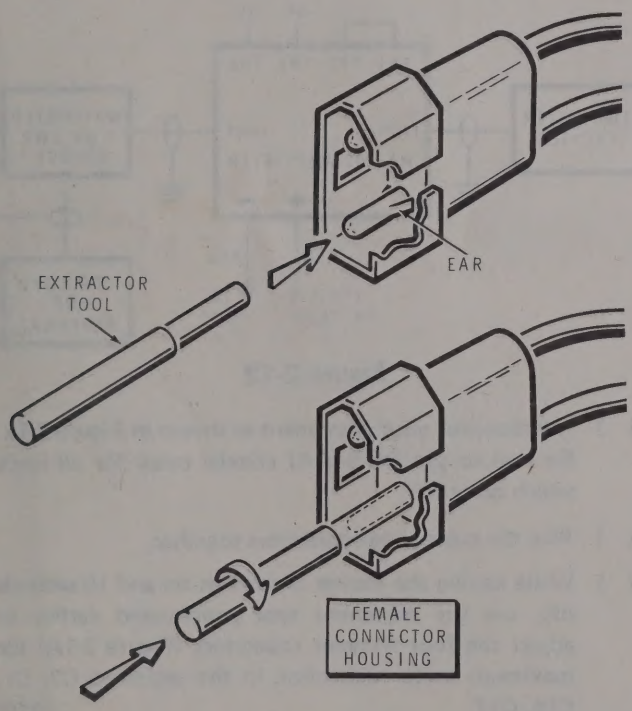


Figure 2-10

NOTE: An extractor tool is furnished (see Figure 2-10) so you can remove a pin from one of the connector housings, should it become necessary. To use the tool, push it very firmly over the end of the pin, as shown, until it compresses the expanded ears of the pin. When this occurs, the wire with its pin can be pulled from the other end of the housing.

( ) Route the free end of the red wire toward the battery and solder it to the remaining lug of the fuse block.

( ) Make sure the male and female connector housings are not plugged together. Then connect the free end of the red wire coming from the fuse block to the battery.

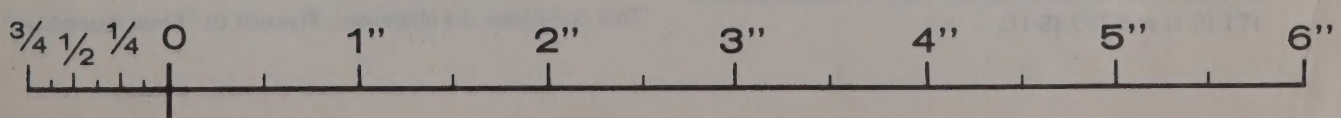
ALIGNMENT

Alignment Notes

1. To avoid overheating and damaging the transistors, do not key the exciter continuously during alignment. A cycle of five seconds on followed by ten seconds off is recommended until alignment has been completed.

2. Although it is unlikely, you could encounter low-frequency oscillation (squegging) under certain conditions of mistuning. When it is properly tuned, the Amplifier will not exhibit these oscillations, but low-frequency spurious output has been observed during alignment, and this condition can destroy Q1 and Q2 if it is allowed to exist for any length of time. A portable broadcast receiver makes a good indicator when it is tuned to an unused frequency and placed near the Amplifier. The existence of squegging will be easily recognized as an unusual noise from the broadcast receiver.

3. If you use your battery as a power source, check the voltage across its terminals with the engine running and all accessory equipment and lights off. This Amplifier is designed for 16 volts maximum input, and if the voltage is in excess of this figure, you should have your voltage regulator adjusted or replaced.



4. It is good practice to start the tuneup procedure at 11 to 12 volts input. If you are using your battery as a power source, leave the engine off during the initial alignment steps. Then start the engine (in a well-ventilated area) for the final tuneup.

5. The relay may chatter until C2 is peaked. This is normal and is due to the low input impedance possible when the Amplifier is mistuned.

6. The alignment of this Amplifier requires the following:

   a. A two-meter exciter (transmitter) capable of five to fifteen watts output.

   b. A 50 Ω nonreactive load, such as the Heathkit Cantenna, connected to the Amplifier's output. An antenna may be used, but its VSWR should be as low as possible, and in no event more than 2:1.

   c. An output indicator. A watt meter (or SWR bridge) is preferred, but a voltmeter may be used. The instructions and the connections for these two devices differ; therefore, separate alignment instructions are given below. Follow the appropriate set of instructions for the alignment equipment you have.

7. Before starting alignment, tune your exciter for maximum output in the portion of the 2-meter band in which you expect to operate. The Amplifier operating range will then be approximately 750 kHz each side of the alignment frequency.

Alignment With a Wattmeter or SWR Bridge

If a wattmeter or SWR bridge is used for alignment, it is important that they be capable of accurate measurements at the operating frequency of the Amplifier; otherwise, there may be a false indication of peak power output, and possible misalignment.

(✓) Refer to Figure 2-11 and cut a capacitor lead (laid aside earlier) to 5/8". Bend the ends down to form a U-shaped connector. Place the ends in connector pins TP1 (S-1) and TP2 (S-1).

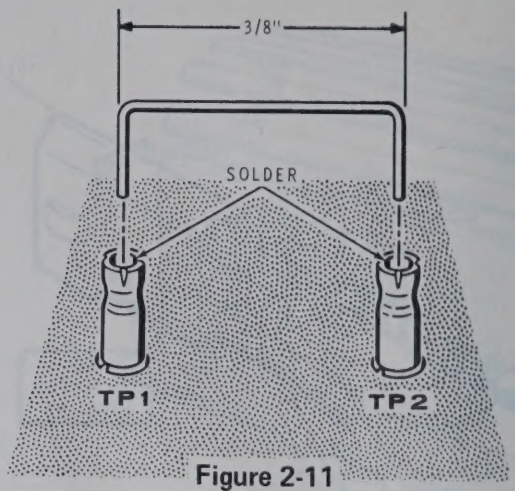


Figure 2-11

(✓) Refer to Figure 2-1A (fold-out from Page 17) and solder the free lead of the 2.7 pF disc capacitor to terminal 4 of the relay. NOTE: A coaxial cable was previously soldered to this terminal.

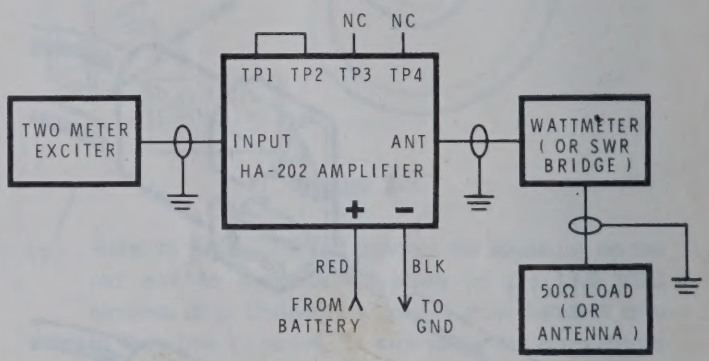


Figure 2-12

( ) Interconnect your equipment as shown in Figure 2-12. Be sure to use RG-58A/U coaxial cable for all leads which carry RF.

( ) Plug the power line connectors together.

( ) While keying the exciter 5 seconds on and 10 seconds off, use the alignment tool constructed earlier to adjust the four trimmer capacitors (Figure 2-1A) for maximum meter deflection in the sequence C2, C1, C16, C17.

( ) Repeat the trimmer adjustment at least twice to assure maximum output.

( ) Disconnect the wattmeter, the 50 Ω load, and the power line connectors.

This completes the alignment. Proceed to "Final Assembly."

4. It is good practice to start the tuneup procedure at 11 to 12 volts input. If you are using your battery as a power source, leave the engine off during the initial alignment steps. Then start the engine (in a well-ventilated area) for the final tuneup.

5. The relay may chatter until C2 is peaked. This is normal and is due to the low input impedance possible when the Amplifier is mistuned.

6. The alignment of this Amplifier requires the following:

   a. A two-meter exciter (transmitter) capable of five to fifteen watts output.

   b. A 50 Ω nonreactive load, such as the Heathkit Cantenna, connected to the Amplifier's output. An antenna may be used, but its VSWR should be as low as possible, and in no event more than 2:1.

   c. An output indicator. A watt meter (or SWR bridge) is preferred, but a voltmeter may be used. The instructions and the connections for these two devices differ; therefore, separate alignment instructions are given below. Follow the appropriate set of instructions for the alignment equipment you have.

7. Before starting alignment, tune your exciter for maximum output in the portion of the 2-meter band in which you expect to operate. The Amplifier operating range will then be approximately 750 kHz each side of the alignment frequency.

Alignment With a Wattmeter or SWR Bridge

If a wattmeter or SWR bridge is used for alignment, it is important that they be capable of accurate measurements at the operating frequency of the Amplifier; otherwise, there may be a false indication of peak power output, and possible misalignment.

(✓) Refer to Figure 2-11 and cut a capacitor lead (laid aside earlier) to 5/8". Bend the ends down to form a U-shaped connector. Place the ends in connector pins TP1 (S-1) and TP2 (S-1).

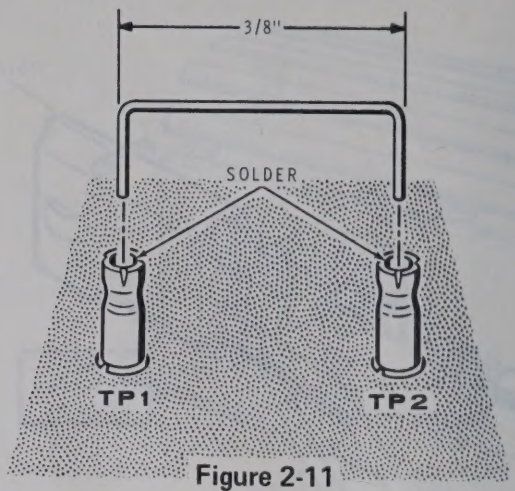


Figure 2-11

(✓) Refer to Figure 2-1A (fold-out from Page 17) and solder the free lead of the 2.7 pF disc capacitor to terminal 4 of the relay. NOTE: A coaxial cable was previously soldered to this terminal.

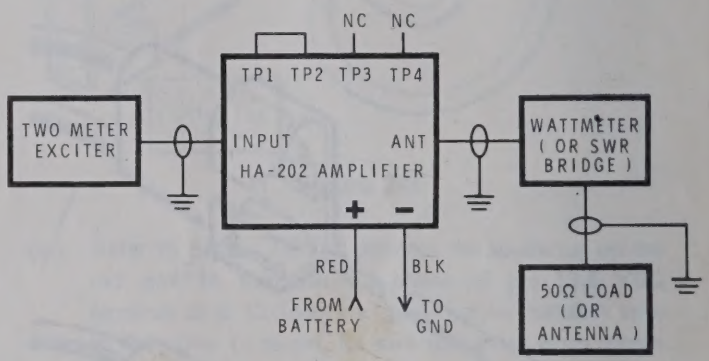


Figure 2-12

( ) Interconnect your equipment as shown in Figure 2-12. Be sure to use RG-58A/U coaxial cable for all leads which carry RF.

( ) Plug the power line connectors together.

( ) While keying the exciter 5 seconds on and 10 seconds off, use the alignment tool constructed earlier to adjust the four trimmer capacitors (Figure 2-1A) for maximum meter deflection in the sequence C2, C1, C16, C17.

( ) Repeat the trimmer adjustment at least twice to assure maximum output.

( ) Disconnect the wattmeter, the 50 Ω load, and the power line connectors.

This completes the alignment. Proceed to "Final Assembly."

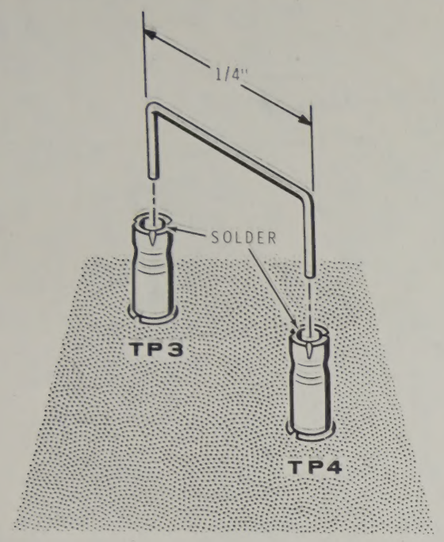


Figure 2-13

Alignment With a Voltmeter

( ) Refer to Figure 2-13 and cut a capacitor lead (laid aside earlier) to 1/2". Bend the ends down to form a U-shaped connector. Place the ends in TP3 and TP4. Use a minimum amount of solder (this connector will be removed later) and solder the connector to TP 3 and TP 4.

( ) Refer to Figure 2-1B and temporarily solder one lead of the 4700 Ω (yellow-violet-red) resistor to lug #1 of the ANT phono socket. NOTE: A coaxial cable was previously soldered to this terminal. Solder the other resistor lead to the free lead of C18, the 2.7 pF disc capacitor.

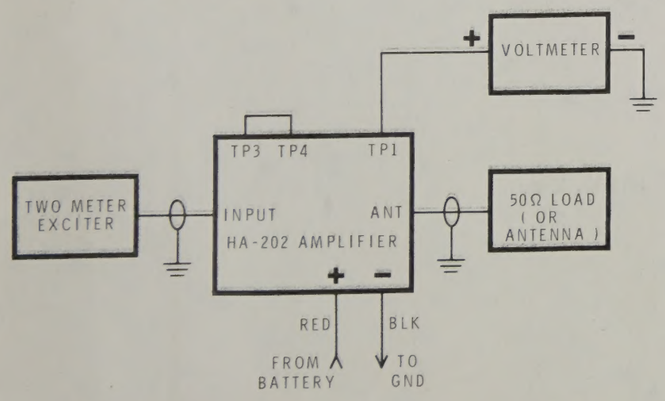


Figure 2-14

( ) Refer to Figure 2-14 and interconnect your equipment. Be sure to use RG-58A/U coaxial cable for all leads which carry RF.

( ) Plug the power line connectors together.

( ) While keying the exciter 5 seconds on and 10 seconds off, use the alignment tool constructed earlier to adjust the four trimmer capacitors (Figure 2-1A) for maximum meter deflection in the sequence C2, C1, C16, C17. Proper tuning is indicated when the voltage at TP1 is at least twice the voltage shown on the meter when the + power wire is disconnected.

( ) Repeat the trimmer adjustment at least twice to assure maximum output.

( ) Disconnect the voltmeter, the load, and the power connectors.

( ) Unsolder and remove the 4700 Ω resistor.

( ) Refer to Figure 2-1A and solder the free end of the 2.7 pF disc capacitor to relay terminal 4.

( ) Unsolder and discard the connector between TP3 and TP4.

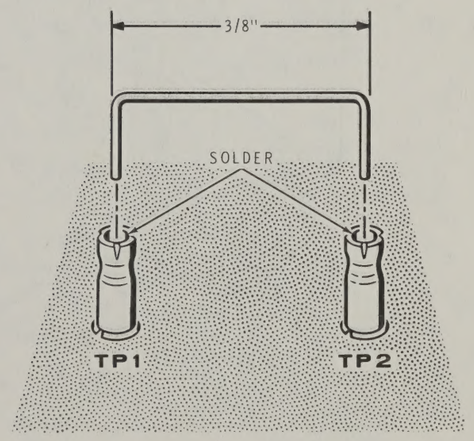


Figure 2-15

( ) Refer to Figure 2-15 and cut a capacitor lead (laid aside earlier) to 5/8". Bend the ends down to form a U-shaped connector. Place the ends in connector pins TP1 (S-1) and TP2 (S-1).

This completes the alignment. Proceed to "Final Assembly."

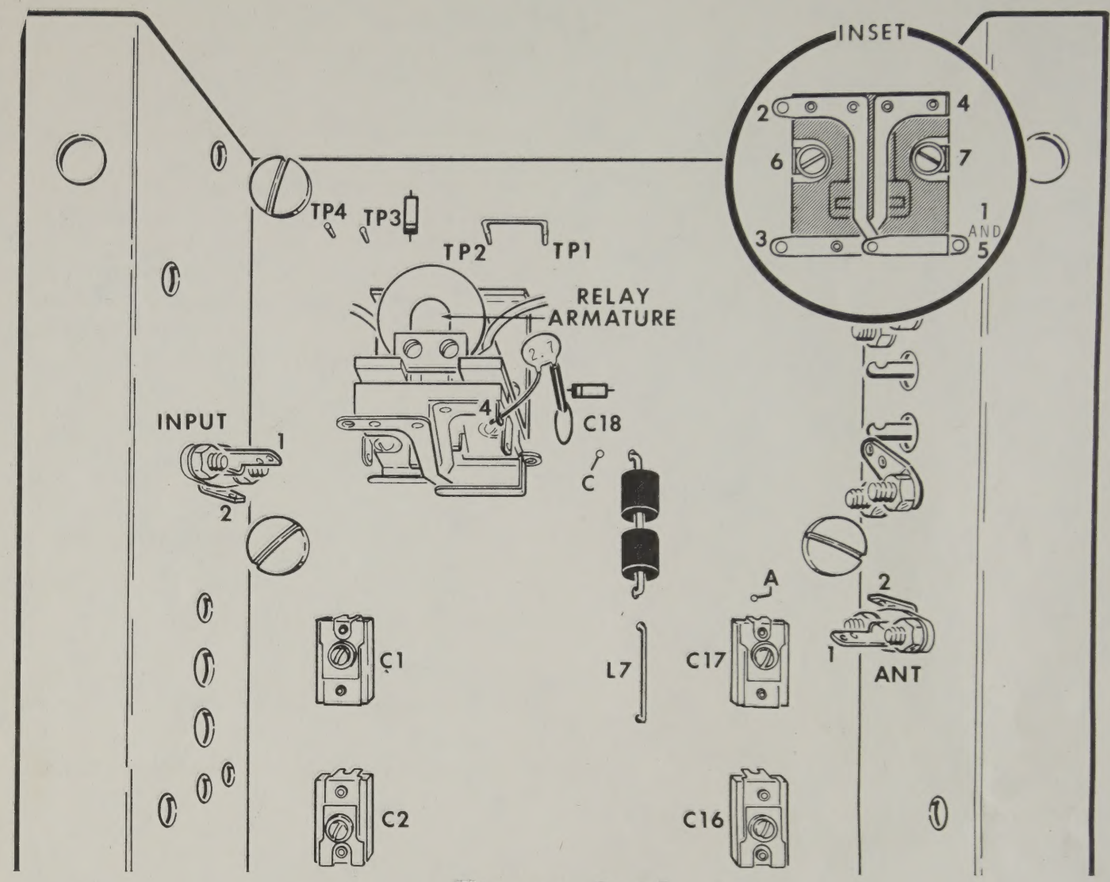


Figure 2-1A

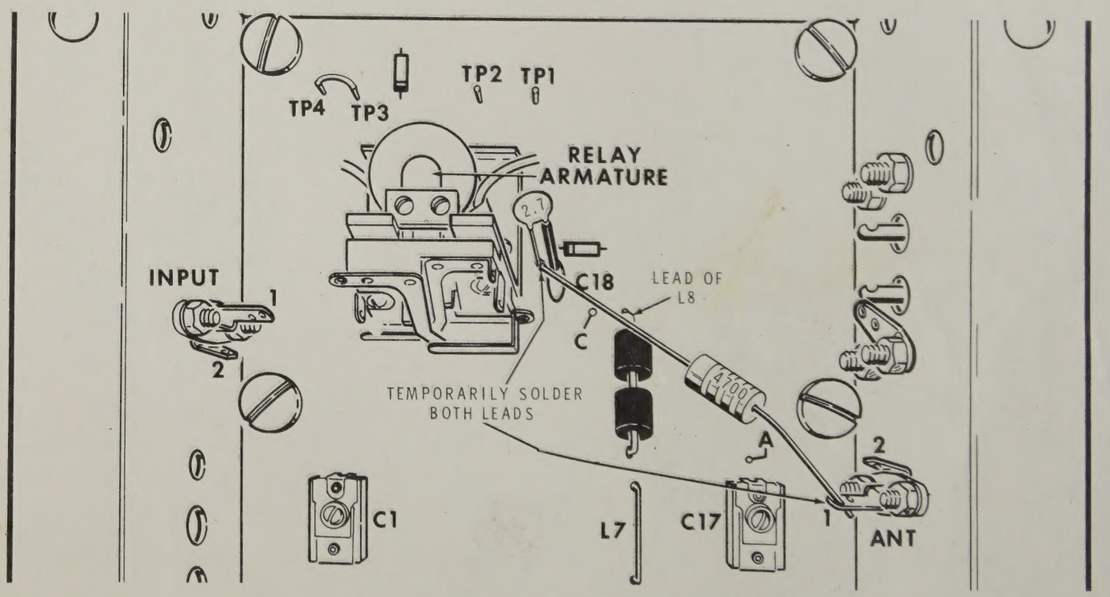
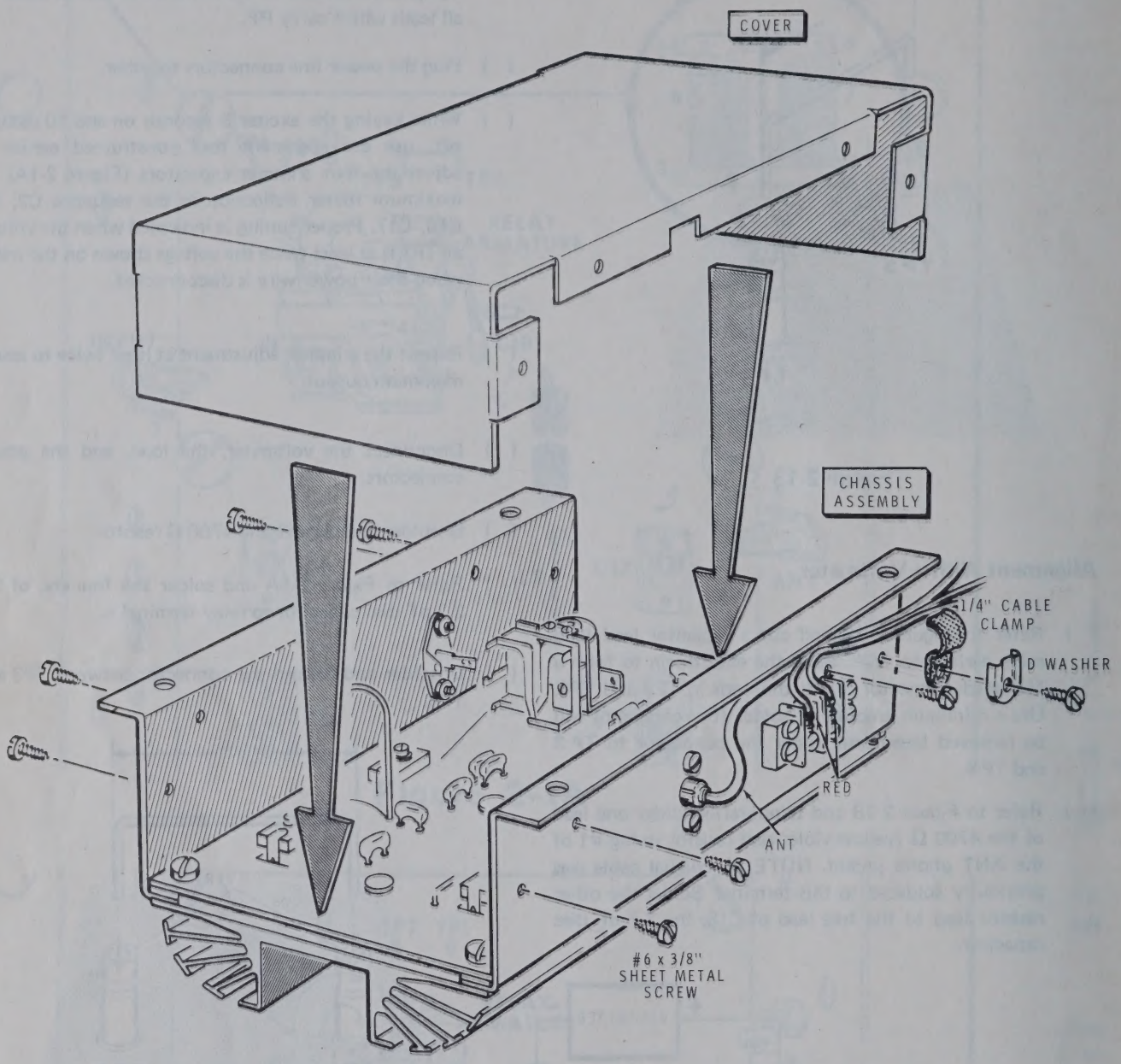


Figure 2-1B



PICTORIAL 2-5

FINAL ASSEMBLY

( ) Refer to Pictorial 2-5 and place the cover on the Amplifier. Secure the cover with four #6 x 3/8" sheet metal screws, a 1/4" cable clamp, and a D washer. Position the antenna coaxial cable and the two power leads under the cable clamp. On the opposite side, use four #6 x 3/8" sheet metal screws and the 3/16" cable clamp. Position this clamp as convenient to hold the input coaxial cable.

( ) Secure the Amplifier in its final position with four #10 x 3/8" sheet metal screws in the holes previously drilled.

( ) Attach the input and antenna coaxial cables.

( ) If not already done, connect the free end of the black power wire to the selected ground point.

( ) Plug the power line connectors together.

This completes the "Installation and Alignment." Proceed to the "Operation" section.

OPERATION

Operation of this Amplifier is entirely automatic. When the exciter is keyed, the amplifier relay will transfer the exciter output to the amplifier input circuits, and the amplifier output to the antenna. In the receive mode, the relay connects the antenna direct to the exciter. Current drain in the receiver mode is negligible (below one mA.).

Low power operation can be secured by reducing the exciter output to less than 1-1/2 watts, which is below the amplifier relay pull-in point. Alternatively, you can install the low power switch mentioned in the "Installation" section to remove power from the Amplifier.

IN CASE OF DIFFICULTY

1. Make sure there are from 12 to 16 volts present at the terminal strip.

2. The majority of the kits that are returned for repair do not function properly due to poor connections and soldering. Many troubles can be eliminated by carefully reheating all connections to make sure that they are soldered as described in the Soldering section of the "Kit Builders Guide."

3. Check the values of the parts installed. Be sure that the proper part has been wired into the circuit for each step as shown in the Pictorial diagrams.

4. Recheck the wiring. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.

5. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

6. Make sure all excess lead lengths have been clipped from the foil side of the circuit board. Unclipped leads could cause a short circuit from the circuit board to the chassis.

7. A review of the Circuit Description may prove helpful in indicating where to look for trouble.

8. In an extreme case where you are unable to resolve a difficulty, refer to the "Service" section of the Kit Builders Guide and to the "Factory Repair Service" section of this Manual on Page 23.

9. When a component (Q1, C2, R3, etc.) is mentioned in the "Possible Cause" column of the "Troubleshooting Chart," check that specific component to make sure it operates properly, together with those parts connected to it.

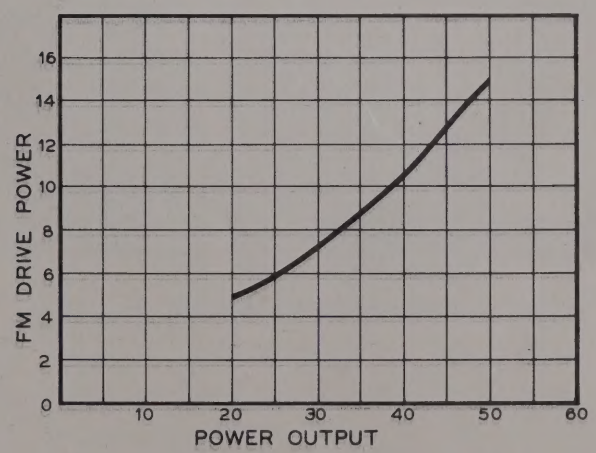
Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSE
Fuse blows when installed.	1. Power leads reversed at Amplifier. 2. C14 installed backwards. 3. C11, C12, C13, C14, C15 or C16 shorted or installed backward. 4. Q1 or Q2. 5. Red power wire shorted to automobile body during installation.
Fuse blows when Amplifier is keyed.	1. Amplifier mistuned. 2. Antenna VSWR excessive. 3. Relay contacts not closing properly. 4. Relay improperly wired. 5. Coaxial cable shorted from center conductor to braid.
Output power is low.	1. Drive power is low. 2. Amplifier mistuned. 3. Relay contacts misaligned. 4. Relay improperly wired. 5. Antenna VSWR excessive. 6. Q1 or Q2.
Relay will not pull in.	1. Drive is low. 2. D1, C18, Q3. 3. TP1 and TP2 not connected together or C18 not connected. 4. Relay (to check relay, jumper TP3 to TP4; relay should pull in). 5. Fuse blown. 6. Input and antenna connections reversed.
Relay pulls in when battery is connected.	1. Q3 or D2. 2. TP3 and TP4 jumper not removed after alignment.
C1, C2, C16 or C17 will not peak (capacitors fully open or compressed).	1. L1 and L9 reversed or wrong dimensions. 2. Antenna VSWR excessive.
Received signals weak with Amplifier in line.	1. Relay contacts not operating properly. 2. Relay wired incorrectly. 3. Amplifier mistuned. (Low frequency oscillation will cause the received signal to sound noisy, or weak.)

SPECIFICATIONS

Frequency Range	143 to 149 MHz (any 1-1/2 MHz segment).
Power Output	See the graph on Page 25.
Power Input (drive power required)	5 to 15 watts FM signal.
Input/Output Impedance	50 ohms.
Input VSWR	1.5:1 maximum.
Load VSWR	3:1 maximum.
Power Supply Required	12 to 16 VDC, 7 Amperes maximum, negative ground.
Standby Current	1 mA.
Operating Temperature Range	–30°F to +140°F.
Dimensions	3" high x 5-1/2" deep x 4-1/4" wide (excluding mounting flanges).
Weight	2 lbs.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.



CIRCUIT DESCRIPTION

The 50 ohm amplifier input impedance is transformed to approximately 5 ohms by C1, C2 and L1. The driving power is then split to drive the two amplifier transistors, Q1 and Q2. C3, L2, C4, C5 and C6 match the base of Q1 to the 5 ohm summing point impedance, and C3, L3, C7, C8 and C9 perform this function for Q2. Three capacitors are used at each base for better current distribution and lower loss. The RFC at the summing point provides a DC return for the bases of Q1 and Q2. Resistors R2 and R3 prevent spurious oscillations.

The collector output impedance of Q1 is matched to the 5 ohm impedance of the output summing point by L6, C11, C12 and C13. Similarly, Q2 is matched by L7, C11, C12 and C13. The 5 ohm summing point impedance is transformed to 50 ohms at the amplifier output by L9, C16 and C17.

DC power is fed to the transistors through L8 which, in conjunction with C14 and C15, isolates the RF voltage at the amplifier transistor collectors from the power supply, and provides a ground for all low-frequency parasitics.

A portion of the input signal is sampled by C18, detected by D1, and filtered by L10, R1 and C19. The resulting DC voltage is used to drive transistor Q3 into conduction, which causes relay K1 to energize and close. When closed, the relay connects the Input socket to the amplifier input and the amplifier output is connected to the Output socket. In the de-energized state, the Input and Output sockets are connected together by the relay to provide a direct path for reception, or for low-power operation. Diode D2 protects Q3 from the transient developed by the relay when it is switched off. TP1, TP2, TP3 and TP4 are used during alignment.

DIODE AND TRANSISTOR IDENTIFICATION

COMPONENT DESIGNATION	PART NUMBER	QUANTITY	TYPE AND RATING	FIGURE
D1, D2	56-56	2	1N4149 DIODE	NONE
Q1, Q2	417-299	2	CTC B25-12 OR 2N5591 TRANSISTOR	A
Q3	417-155	1	2N3641 TRANSISTOR	B

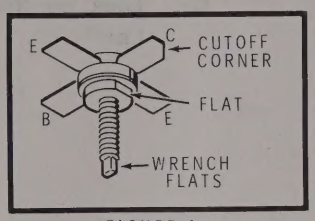


FIGURE A

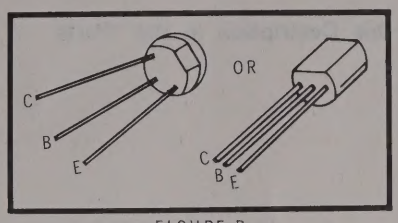


FIGURE B

CIRCUIT BOARD X-RAY VIEWS

NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed in either of the following ways:

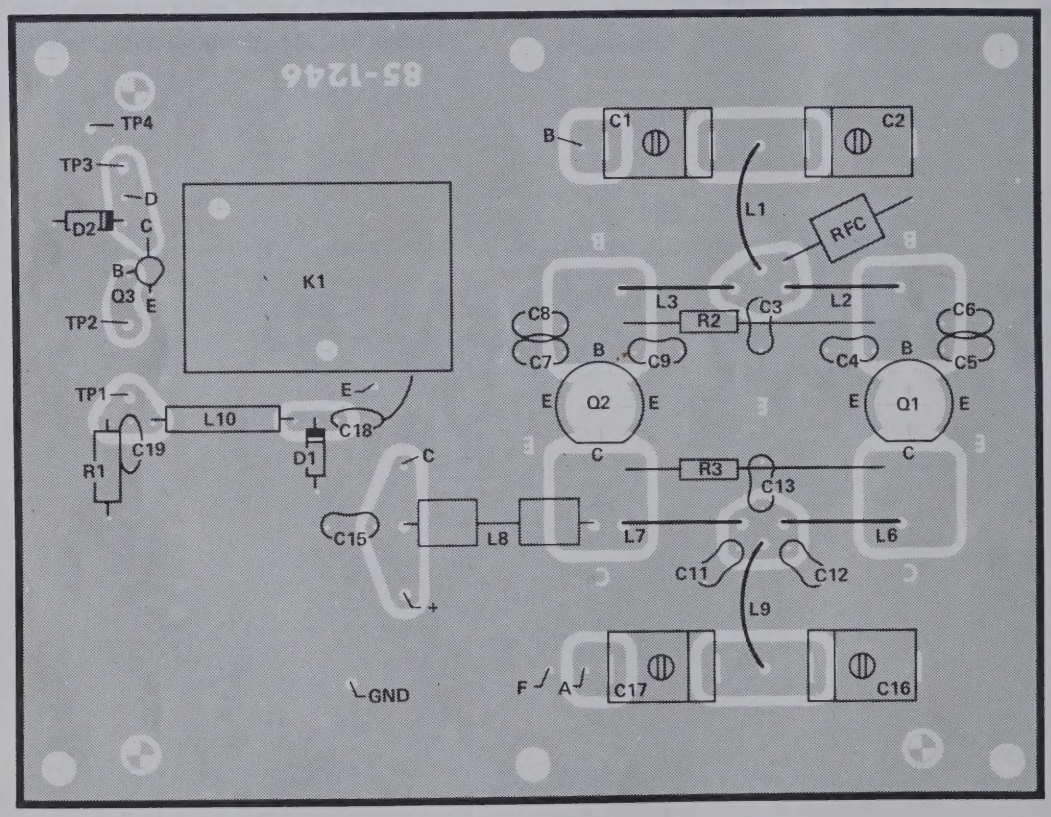
1. A. Refer to the place where the part is installed in the Step-by-Step instructions and note the "Description" of the part (for example: 22 kΩ, .05 μF, or 2N2712).

   B. Look up this Description in the "Parts List."

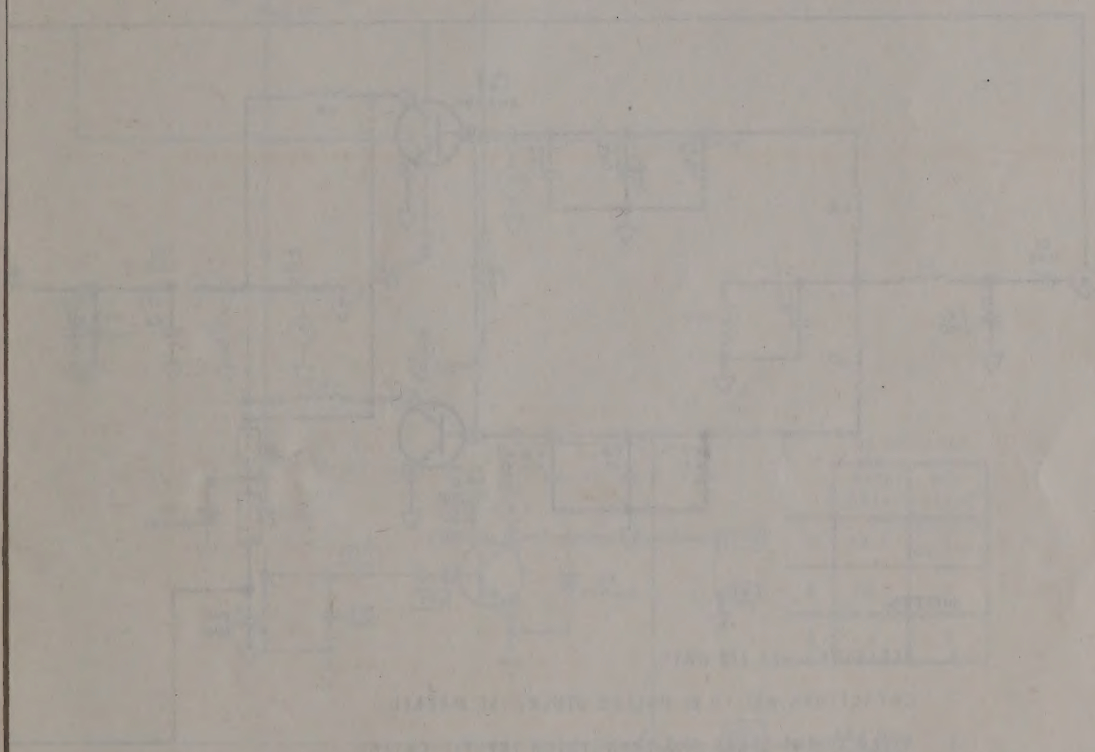
2. A. Note the identification number of the part (R-number, C-number, etc.).

   B. Locate the same identification number (next to the part) on the Schematic. The "Description" of the part will also appear near the part.

   C. Look up this Description in the "Parts List."



(Viewed from foil side)



CIRCUIT BOARD X-RAY VIEWS

NOTE: To identify a part shown in one of these Views, so you can order a replacement, proceed in either of the following ways:

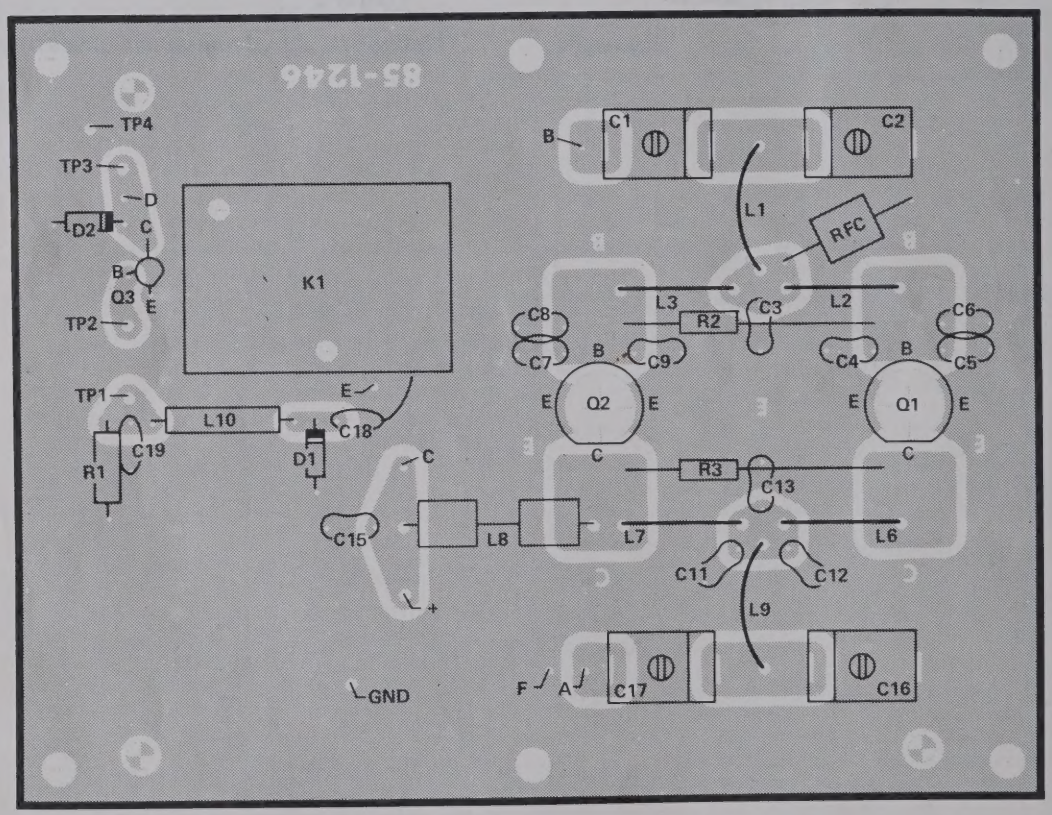
1. A. Refer to the place where the part is installed in the Step-by-Step instructions and note the "Description" of the part (for example: 22 kΩ, .05 μF, or 2N2712).

   B. Look up this Description in the "Parts List."

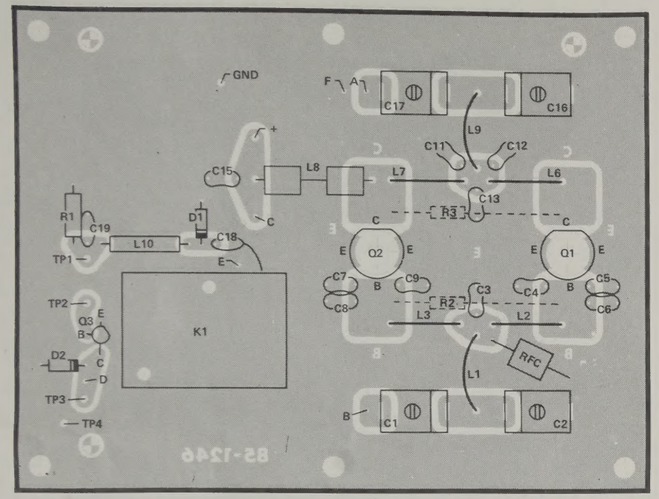
2. A. Note the identification number of the part (R-number, C-number, etc.).

   B. Locate the same identification number (next to the part) on the Schematic. The "Description" of the part will also appear near the part.

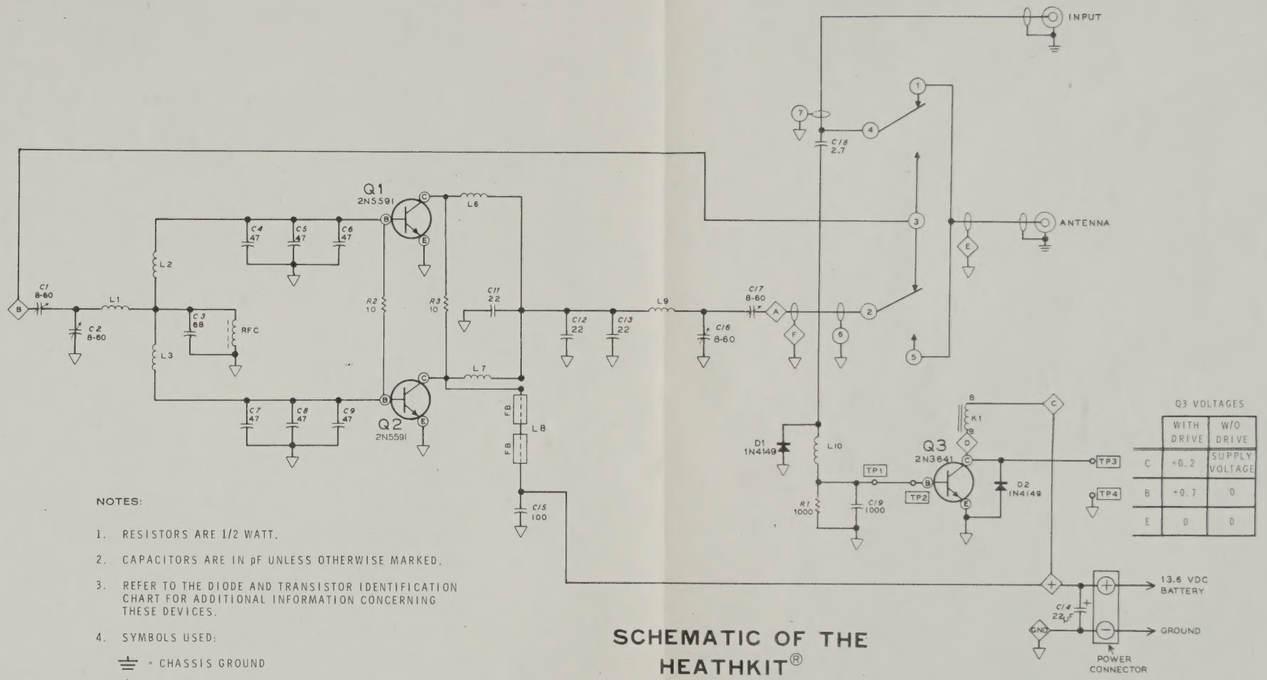
   C. Look up this Description in the "Parts List."



(Viewed from foil side)



(Viewed from component side)



Q3 VOLTAGES

	WITH DRIVE	W/O DRIVE
C	+0.2	SUPPLY VOLTAGE
B	+0.7	0
E	0	0

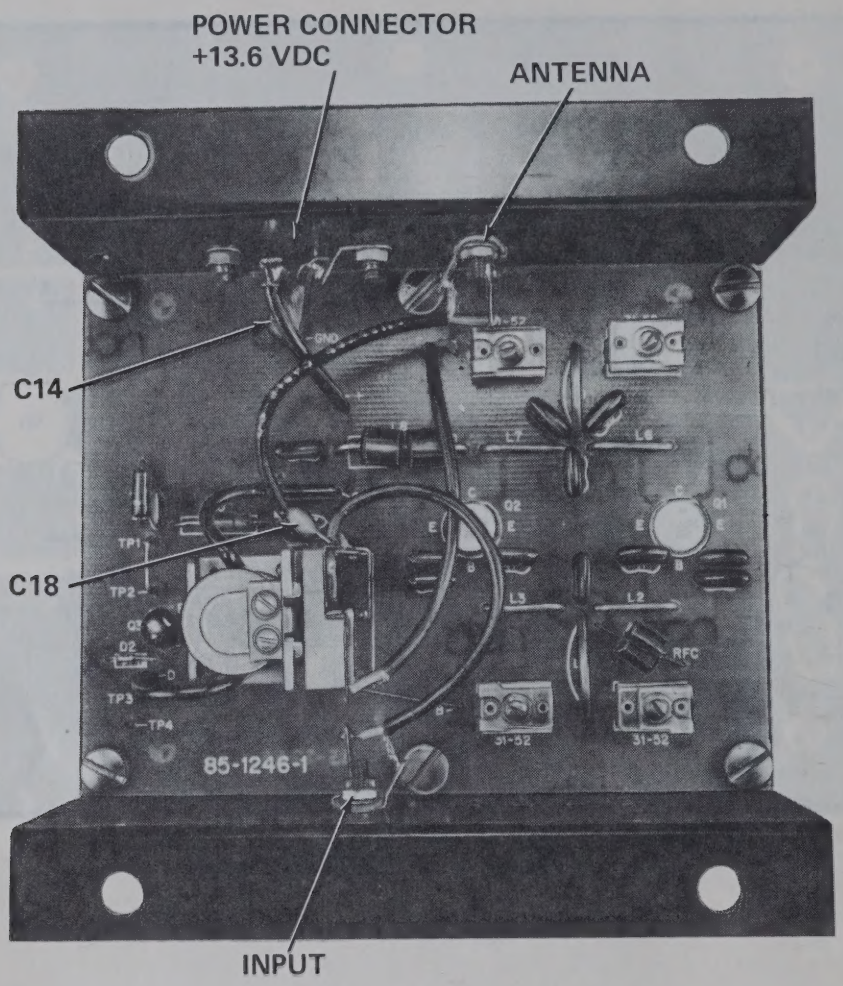
NOTES:

1. RESISTORS ARE 1/2 WATT.
2. CAPACITORS ARE IN pF UNLESS OTHERWISE MARKED.
3. REFER TO THE DIODE AND TRANSISTOR IDENTIFICATION CHART FOR ADDITIONAL INFORMATION CONCERNING THESE DEVICES.
4. SYMBOLS USED:
   - = CHASSIS GROUND
   - = CIRCUIT BOARD GROUND
   - = RELAY TERMINAL
   - = CIRCUIT BOARD CONNECTION
   - = TERMINAL STRIP CONNECTION
   - FB = FERRITE BEAD

SCHEMATIC OF THE HEATHKIT®

2-METER FM AMPLIFIER MODEL HA-202

CHASSIS PHOTOGRAPH



CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

Replacement parts are maintained specifically to repair Heath products. Parts sales for other reasons will be declined.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.